The Journal of the American Association of Nurse Anesthetists

IN THIS ISSUE

OPINION REVIEW
Inactive Membership Status 66

EDITORIAL
A Question of Value 73

ANESTHETIC AGENTS WITH PHYSICALLY MEDIATED ACTIONS 74
Joe B. Nash, Ph.D.

CONTROL OF DEPTH DURING COMBINED ANESTHESIA 78
Jay Jacoby, M.D., and William Hamelberg, M.D.

DISASTER ANESTHESIA 83
Max S. Sadove, M.D., John T. Nelson, M.D., Gordon M. Wyant, M.D., and Lloyd Gittelson, M.D.

RADIOACTIVE ISOTOPES IN MEDICINE 91
Adolph Kraft, M.D., and William Wolf, M.D.

CEREBRAL DAMAGE FROM ANOXIA DURING CHILDBIRTH 97
Clement A. Smith, M.D.

REDUCTION OF MORBIDITY AND MORTALITY IN OBSTETRIC ANESTHESIA 102
Newlin F. Paxson, M.D., Franklin F. Snyder, M.D., Clement A. Smith, M.D., August Groeschel, M.D., Victoria Scullen, R.N., and Mary A. Costello, R.N.

NOTES AND CASE REPORTS 117

LEGISLATION 120

ABSTRACTS 124

BOOK REVIEWS 128

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Volume XXI MAY 1953 Number Two

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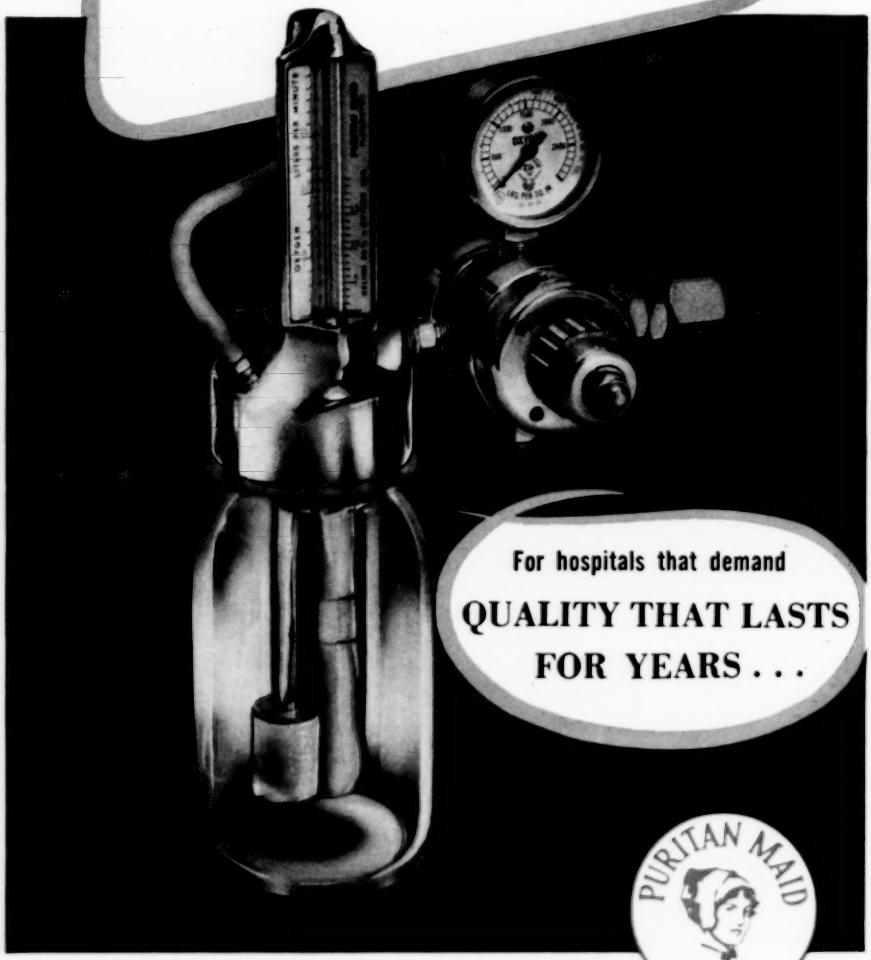

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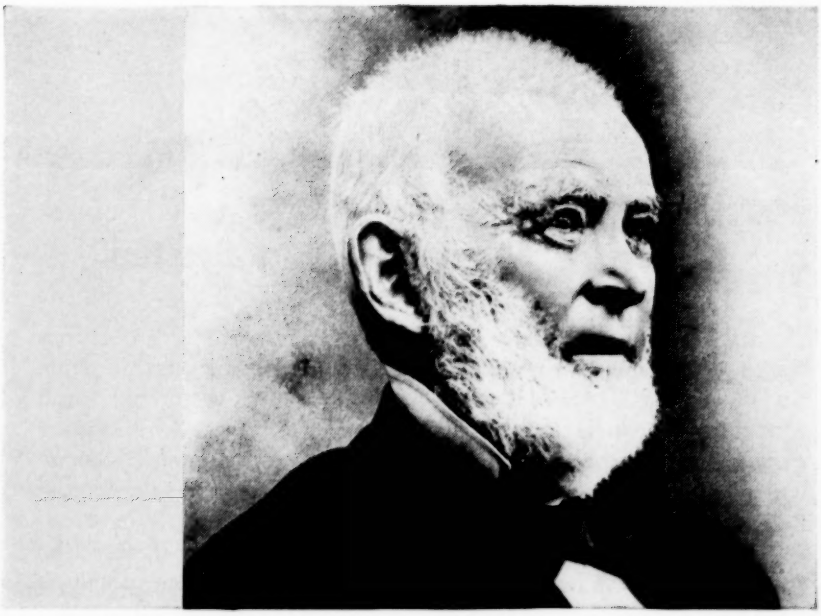

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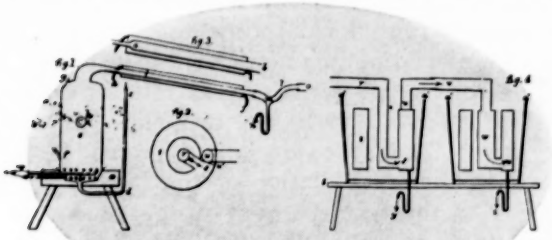


Diagrams for Early Ether Still from "Apparatus for the Preparation of Ether by Steam" Edward R. Squibb, M.D., The Journal of American Pharmacy, Sept. 1856.

Opinion Review

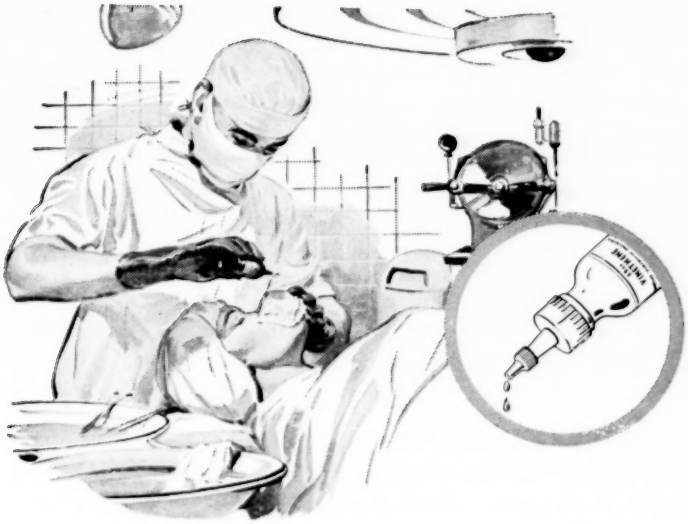
Inactive Membership Status

The status of inactive membership in the A.A.N.A. carries with it the requirement that members in this category refrain from administering anesthesia under any circumstances for the fiscal year during which they hold such membership. Some nurse anesthetists have contended that this not only works a hardship on retired anesthetists who would, in an emergency or upon the request of family or friends, be making a positive contribution by administering the anesthesia but also limits the number of anesthetists who might be available for vacation and emergency relief. Accordingly, it has been proposed that the A.A.N.A. bylaw on inactive membership be revised to permit inactive members to administer anesthesia for thirty days during any fiscal year. Since this question is one in which every member has both a present and potential interest, it is being discussed in Opinion Review in this issue of the JOURNAL. *Additional contributions will be welcome.*

The purpose of the bylaw on inactive status is to provide a means whereby those members who, for various and sundry reasons, are not currently engaged in practicing their profession, may resume active status at a future date. The bylaw states: "If at some future date I return to the practice of anesthesia, I shall notify the Executive Director immediately and pay the dues of an Active Member for the current fiscal year. Failure to comply with this ruling shall be cause for termination of my membership without recourse to reinstatement."

We are confronted from time to time with the problem arising from the administration of an occasional anesthesia by an inactive member. While this would constitute a violation of the bylaw on inactive membership, it could also be the result of a need to cover a service in an emergency. Then, too, we have to consider the element of human frailty in a deliberate violation of the bylaw.

In view of the fact that our primary concern is the patient and that there exists an acute shortage of anesthetists, particularly in the smaller communities, it seems to me that it would be the responsibility of the inactive member, when possible, to meet the emergency should an urgent need arise. If the service is remunerative, she will likely re-



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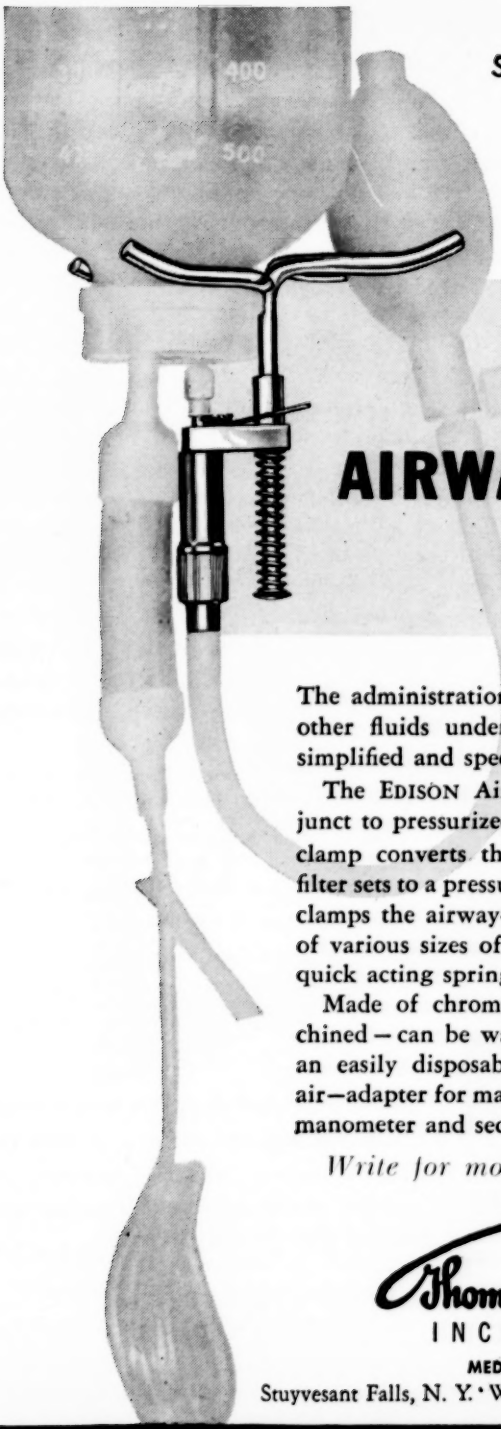
ceive an amount sufficient to pay the current dues. If it is not a remunerative service, the hospital administrator should be fully advised, and possibly arrangements could be made through him for the necessary amount. If the service is strictly charity or if other extenuating circumstances exist, the exceptions may be clearly defined and a report submitted to the Executive Director for decision.—**Anne Beddow, R.N., Birmingham, Ala.**

Since inactive memberships, in my estimation, will increase in the next few years and then become stabilized, the matter requires considerable thought and anticipation.

We not only need these inactive memberships, we want them. And the financial remuneration to the treasury of the Association is the last consideration. We need the maturity of the inactive members to mellow our decisions and judgments. We need their experience, which will enrich younger minds.

In light of the members who will soon be ready for retirement, the idea of liberalizing the inactive membership requirements in the bylaws is a good one at *this time*. First, in view of the shortage of anesthetists, the proposed liberalized bylaw would permit inactive members to administer anesthesia in emergencies and during vacation periods. They could keep their "hand in." Naturally on becoming inactive one's income shrinks, and the dues for active membership would be a burden, whereas the additional income that might be earned by the inactive member if permitted to work a limited time each year would be welcome. The same problem and solution apply to the younger anesthetist who takes this form of membership because of marriage but who does not want to give up the privileges of membership in the Association. But, if and when, the ranks are filled and the supply of anesthetists should catch up with the demand, then this very thirty day clause (as suggested as an amendment to the *Bylaws*) may work a hardship on the active membership group. In large institutions the rotation for vacations might well provide full-time employment for an anesthetist, whereas in such a community twelve inactive anesthetists being permitted to work thirty days each might cover the situation. Then the more liberal rule may cause a hardship and a disgruntled active membership. Also, aren't we depriving the Association of much of value by depriving the inactive members of the right to vote and work on committees? These women have much to contribute both by experience and because of their more leisurely way of life.—**Madeleine King, R.N., Meadville, Pa.**

In thinking of revising the *Bylaws* to liberalize the requirements for inactive status there are two viewpoints. There are inactive members who would like to give a few anesthetics in consequence of requests by family or friends, emergencies, relief for vacations, or illness. To deny them the privilege may seem extreme, and many in this cate-



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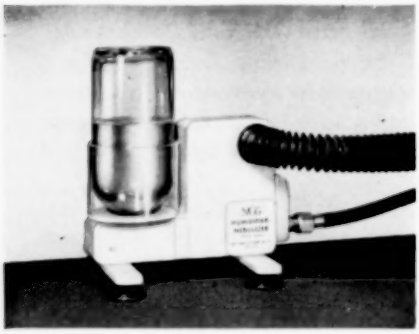
gory are paying active dues in order to give a very occasional anesthetic. However, there are the active members who carry the work load in the hospitals, who by their activities and votes carry the work of the organization, and who with their dues support its projects. A relief anesthetist in thirty days would be paid a minimum of three hundred and fifty dollars from which active dues could be paid. Such an anesthetist will work "by the case" or on straight day duty to help with the posted schedule but not to relieve the load of night or call duty. It seems futile to attempt to set up degrees of activity or inactivity in order to determine how many days one may practice anesthesia and still be considered "inactive." Rather than a blanket change in the *Bylaws* permitting all inactive members to work as much as thirty days a year, there seem to be two alternatives: (1) A change permitting inactive members to give six to ten anesthetics a year. This would take care of request cases and an occasional emergency. (2) A change giving flexibility to the present bylaw by providing for consideration of special cases. Then an inactive member living in an isolated area who might be called upon in an emergency (probably unremunerative) could request leniency while in that situation. Either of these changes might be advisable, but for a member on inactive status to give anesthetics for remuneration would seem to be "eating the cake and having it too."—**Minnie V. Haas, R.N., Fort Worth, Tex.**



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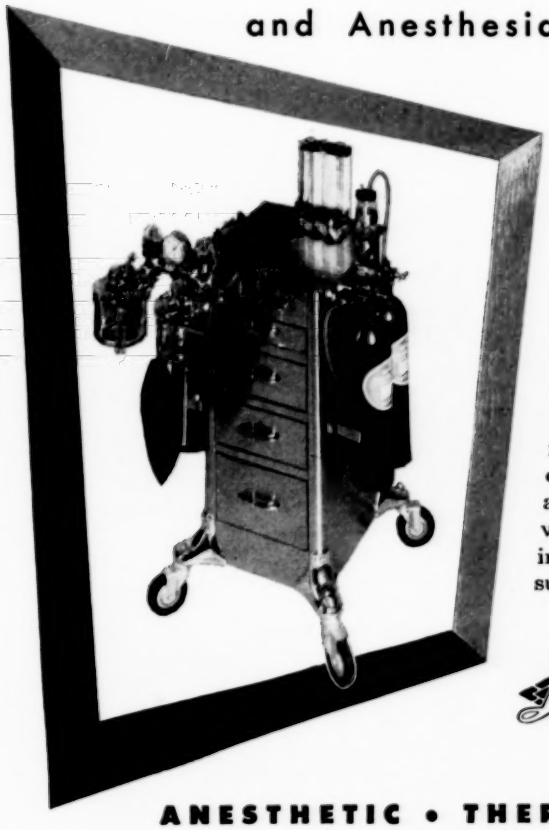

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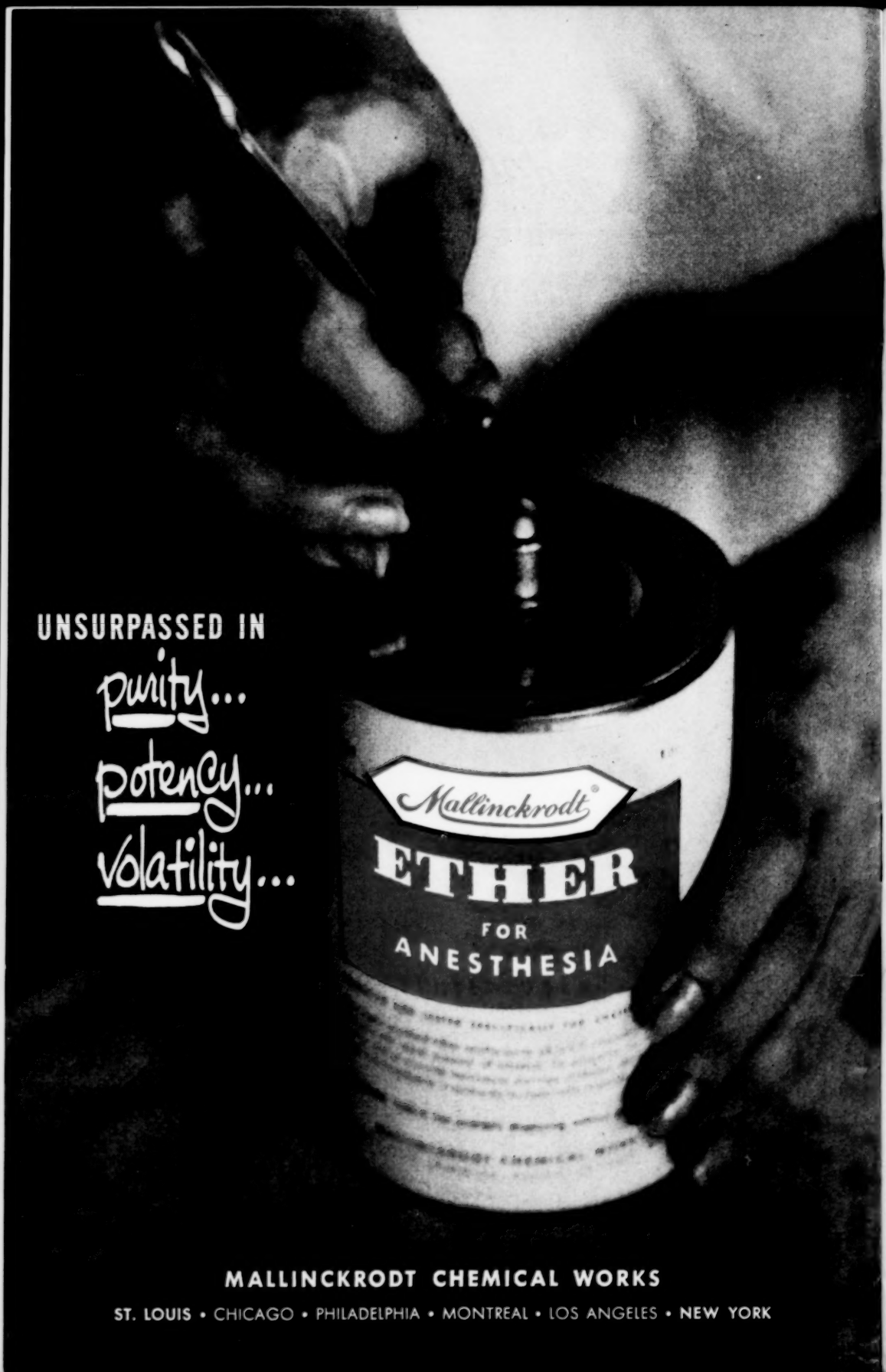

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The Journal OF THE American Association of Nurse Anesthetists

Vol. XXI No. 2 May, 1953

A Question of Value

When it comes to garrotting "the goose that . . ." top honors are going to recent graduates in anesthesia—and uncontested. For the most part, seasoned anesthetists don't covet the distinction. Perhaps the fledglings wouldn't either if they considered the cost—and we don't mean to hospitals.

Anesthesia service that emphasizes the employment of nurse anesthetists has two specific and acknowledged economic assets. First, the patient is spared unnecessarily high fees, and, second, the department's financial reserves are not depleted. So when we hear of some of the conditions of salary and hours being demanded by recent graduates we frankly wonder who they think they are. The sum of their efforts is to make hospital administrators question the sincerity of the A.A.N.A.'s published statement of principles on personnel policies for nurse anesthetists—and also to inject the poison of discontent into the relations of the anesthesia staff with the hospital administration.

While there are certain workers in every field who deserve the highest compensation because of the substandard or difficult conditions under which they work, or because of their superior abilities or contributions, except for rare instances, we don't think this applies to recent graduates in anesthesia. We further submit that it is an uncommon person who underestimates his worth, particularly when it comes to job pay.

We suggest that it might be healthier for all concerned if the job seeker would look at the value of what he is actually able to do rather than at the highest salary and plushiest working conditions that the field affords.

P.S. Administrators of anesthesia service often wouldn't find themselves outraged by the demands of young inexperienced anesthetists if they had taken a little better care of some of the old faithfuls to whom the habitual answer was "No."

Anesthetic Agents with Physically Mediated Actions

Joe B. Nash, Ph.D.*
Galveston, Tex.

The first implication that anesthesia is mediated by physical means was proposed approximately a century ago by Bibra and Harliss[1] in 1847. These workers postulated from experimental results obtained by long-term anesthesia that certain fatty constituents of the brain were dissolved by the anesthetic agent and redistributed in the liver. Hermann[2] extended these observations and considered the lipoids involved were possibly lecithin, cholesterol, and fat. These works comprised the foundation of the Meyer-Overton[3, 7] lipoid theory.

Until now the Meyer-Overton theory is the only one that has gained widespread acceptance. While it is not entirely satisfactory and is far too simple, most of the known factors can be brought better into relationship with it than any other theory.[4] Meyer made his fundamental propositions as follows:

All chemically indifferent bodies, which are soluble in fats or fatlike substances, must act as narcotics to living protoplasm insofar as they can become distributed within it. Their action must appear first and more markedly in those cells in whose chemical structure these fatlike substances predominate and form peculiarly essential participants in the cell function.

In his excellent reviews Henderson[4] stated that the last of the postulates laid down by Meyer, namely, that the relative degree of activity of narcotics must depend upon their mechanical affinity to the fatlike substance on the one hand and to the other constituents of the body, chiefly water, on the other, and consequently on the distribution coefficient, which determines their distribution in a mixture of water and fatlike substance, is evidently not regarded by Meyer as binding in the case of the highly volatile substances such as Kurt H. Meyer and his co-workers[5] studied. There is variability among the very volatile anesthetics. For example, meth-

From the Department of Pharmacology and Toxicology, University of Texas Medical Branch.
Read before the Nineteenth Annual Meeting of the American Association of Nurse Anesthetists, Philadelphia, Sept. 17, 1952.
*Fellow of the American Foundation for Pharmaceutical Education.

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3. Meyer, H. H.: Arch. f. exper. Path. u. Pharmakol. **42**: 109, 1899.
4. Henderson, V. E.: Physiol. Rev. **10**: 171, 1930; Henderson, V. E., and Brown, W. E.: J. Pharmacol. & Exper. Therap. **29**: 269, 1926.
5. Meyer, K. H., and Gottlieb-Billroth, H.: Ztschr. f. physiol. Chem. **112**: 55, 1920.

ane has a much higher distribution coefficient than N_2O, C_2H_4, C_2H_2, $(C_2H_5)_2O$, or C_3H_8 and presumably should be a more potent anesthetic, yet it is a relatively weak anesthetic presumably because of low solubility in blood upon which it is dependent for initial distribution; however, ethylene has a water solubility of only four times that of methane, and it is a promptly active agent. Also this theory is not without other irregularities from the standpoint of methods used in experimental findings and a lack of confirmation of parts of the original work of Meyer.[6] Overton[7] extrapolated distribution coefficients for some of the anesthetic agents from known water and oil solubilities. This method of determination was shown to be fallacious by Wroth and Reid.[8] Many other factors involved in the early experimental technics were not comparable to those in the intact animal. Meyer[3] employed a mixture of water and olive oil, which was criticized by Aiello[9] who used a serum-oil system to obtain distribution coefficients widely divergent from those found by Overton[7] and Baum.[10] Even Aiello's correction would give somewhat less than 50 per cent of the required assemblage of optimal conditions for the determination of a true distribution coefficient in living animals if one gives consideration to the presence of numerous lipoids, such as cholesterol, sphingomyelin, lecithin, cephalin, and various cerebrosides, compounds that could not be expected to be present as simple mixtures but forming complex structural, metabolically active orders, which would be impossible to reconstruct in vitro.

In view of these experimental limitations it is surprising that the simpler systems exhibit as many close correlations with narcotic activities and potencies as proposed by these earlier workers.

More recently Quastel and Wheatley[11, 12, 13] attempted to explain narcotic activity as being a reflection of these agents on brain respiration. Employing brain slices they showed an inhibition of respiration by barbiturates corresponding to pharmacologic activity of these compounds in vivo. While these observations were confirmed by others,[14, 15, 16] in no cases were the concentrations employed comparable with concentrations producing anesthesia in the intact animal. In view of the evidence presented by Warburg,[17] Weizsäcker,[18] Usui,[19] and Winterstein,[20] Henderson[4] categorically stated that oxidative processes and narcosis are separate phenomena. This also received support from the observations of Emer-

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19. Usui, R.: Arch. f. d. ges. Physiol. **157**: 100, 1912.
20. Winterstein, H.: Biochem. Ztschr. **70**: 130, 1915.
4. Henderson, V. E.: *Loc. cit.*

son,[21, 22, 23] who found that normal anesthetic concentrations of ether have no direct chemical action on the dehydrogenase systems involved in carbohydrate metabolism in mammalian brain due presumably to the limiting of available carbohydrate. Likewise this investigator found that the phenomenon of bioluminescence in the *Lampyrid, Photuris pennsylvanica,* which energy is presumed to be due to dehydrogenase activity, is not altered by concentrations of ether capable of producing anesthesia.

Seevers and Shideman[15] summarized their findings in the statement that the pharmacologic actions of morphine and its derivatives have not been established on a biochemical basis, and the insignificant effect of morphine in a concentration one hundred times that which might be expected in vivo on the autoxidative oxygen uptake of rat cerebrum inspires the question as to the validity of this type of approach to the basic problem of morphine action.

Field[24] and Martin[25] summarized the case for decreased phosphorylative and oxidative mechanisms with implications that chemical reactivity is involved in anesthesia; however, there is no explanation offered for the lack of anesthetic activity of cyanide or other enzyme inhibitors.

Recently our colleagues Cooper and associates[26] reported slightly increased blood acetaldehyde levels in antabuse-treated animals anesthetized with ether, chloroform, vinyl ether, and cyclopropane. While the first three of these agents would be expected to produce this effect, as they contain alcohol, it was surprising that an increased acetaldehyde level was induced by cyclopropane. In light of Cooper's findings and those of Bourne[27] on the increased toxicity of ether containing 1 per cent or more of added acetaldehyde, it was deemed advisable to estimate the effect of antabuse (tetraethylthiuram disulfide, TETD) on induction time and the lethality of anhydrous ether. Although it is generally assumed that ether is nearly inert and not metabolized, no conclusive evidence has been presented that this compound is not partially metabolized. It has been assumed that partial hydrolysis would be the more probable degradation scheme, therefore TETD should serve as an indicator that would produce increased toxicity by analogy to its physiologic effect after the administration of alcohol. It was noted in a previous article[28] that it was unlikely that such was the case, for alcohol is slowly metabolized in the body in contrast with its rapid physiologic effects.

Experimental

Induction time.—Induction times were estimated in a control group of 20 adult white mice of both sexes using Mallinckrodt anhydrous ether in oxygen, 2.5mM./L., the liminal anesthetic concentration at 20 C.; the 1.25 L. suction flask was flushed thoroughly with

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28. Nash, Joe B., and Emerson, G. A.: Texas Repts. Biol. & Med. **9**: 59, 1951.

oxygen between anesthesias. This is essentially the technic of Führer.[29] The anhydrous ether contained not more than 0.01 per cent alcohol. After the induction times were approximated, three daily doses of TETD, 0.25 Gm. per kg., were administered orally by intubation to the same animals that served as controls, and the induction times estimated twenty-four hours after the last dose of TETD. On the following day the effect of 2.5 mM. of ether USP on righting reflex time was estimated. Ether USP contains approximately 2 per cent alcohol and 1 per cent water; therefore the 2.5 mM. ether concentration was calculated on the basis of 97 per cent ether content.

Acute toxicity of ether administered parenterally.—Two groups of 10 mice each with mean weights of 24.8 and 23.8 Gm. respectively were given 0.03 cc./Gm. intraperitoneally of an aqueous 8 per cent ether solution prepared from anhydrous ether. The latter of these groups had previously received three daily oral doses of TETD, 0.25 Gm./kg.

Acute toxicity of ether by inhalation.—The LD_{50} of ether at 10 minutes was established as 4.5 mM./L. by Knoefel.[30] TETD, 0.25 Gm./kg., was administered orally to 17 white mice, and the mice were exposed to anhydrous ether, 4.5 mM./L., as described above.

Results and Discussion

While the mean times of loss of righting reflex, in minutes, were estimated to be 4.48 ± 0.525, 5.50 ± 2.18, and 4.61 ± 1.58, in controls, animals treated with ether and TETD, and animals treated with USP ether and TETD, respectively, the variability between the groups can be interpreted as being due to the physical debility as established by TETD, which in some mice obtunded the excitement stage usually seen in animals exhibiting no gross manifestation of indisposition. Induction times were increased up to 11.68 minutes in mice obviously ill.

The finding that TETD conferred partial protection against ether parenterally injected is unexplainable except on the basis of interference with absorption. 9/10 control animals died, whereas only 5/10 of the TETD-treated mice were killed.

4.5mM./L. of ether killed 9/17 of TETD-treated mice at 10 minutes. This is not significantly different from the LD_{50} in normal mice as reported by Knoefel.[30]

From these data, it is evident that TETD does not increase narcotic potency of ether by inhalation as reflected in loss of righting reflex time or increased lethality. Allen[31] stated that the increased blood acetaldehyde levels in anesthetized rabbits pretreated with TETD, studied by Cooper and himself, were not significantly divergent from normal ranges. This may be interpreted as an additional secondary metabolic effect of ether such as described by Leake[32] and those occurring during chloroform anesthesia as summarized by Loewi.[33]

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Control of Depth during Combined Anesthesia

Jay Jacoby, M.D. and William Hamelberg, M.D.*
Columbus, Ohio

Introduction

Among the significant changes in anesthesia that have taken place in the last decade is the increasing popularity of "combined anesthesia." This term is defined as the administration of several anesthetic agents to one patient at the same time or in close succession. When several agents are used, they act in a synergistic or additive manner, so that the dose of each is small. In this way the advantages of each agent may be obtained, while the disadvantages of large doses may be avoided.

The combinations commonly used include drugs for premedication and for anesthesia. The drugs used for premedication are a belladonna derivative, a narcotic, and/or a barbiturate. For the actual anesthesia a barbiturate, a muscle-relaxing agent, and an inhalation agent are ordinarily used; sometimes a narcotic or a local anesthetic drug may also be injected intravenously, or a local anesthetic drug may be used regionally. In the future additional anesthetic agents will undoubtedly be introduced into common clinical use.

Years ago it was often said that the anesthetist was presented with a bewildering array of agents and methods from which a selection had to be made. With combined anesthesia the anesthetist is faced with the problem not only of selection but also of the use of a greater array of agents at the same time for the same patient. We often hear surgeons say, "When so many drugs are being used, how in the world can you tell what is happening to the patient?" Not only does the surgeon ask this embarrassing question, but also the anesthetist is frequently unable to provide a satisfactory answer.

Present Classification of Depth of Anesthesia

In the teaching of anesthesia the Guedel chart, in which anesthesia is divided into four stages and four planes, is always used. This chart was devised for application to ether anesthesia, and for this purpose it is unexcelled. However, the signs used in the Guedel chart either are not present or are not reliable when combined anesthesia is administered. Not only

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is the beginner confused but also it is often impossible for the experienced anesthetist to determine with any degree of certainty where the patient is in relation to a numerical classification of anesthetic depth.

Minimal Dose of Anesthetic

Even if a numerical classification of anesthetic depth is applicable to a particular patient, it does not fulfil the need of the anesthetist to know whether the optimal depth of anesthesia has been achieved.

Before going on to the main topic of this article, let us consider a basic principle in anesthesia. The anesthetized patient is not in the same condition as a person is in a natural sleep; anesthetics are poisons. The administration of anesthesia is a dangerous undertaking, both because the drug itself may produce harmful changes in the physiologic mechanisms of the body, and because with loss of consciousness the patient loses control of his airway, and respiration may become obstructed or depressed. The greater the quantity of anesthetic given and the deeper the plane of anesthesia, the more harmful they may be. The anesthetist should give just enough drug and have the anesthesia just deep enough for the operation to be easily and quickly performed. If the anesthetic is administered in an amount greater than necessary, a disservice is done to the patient.

For this reason there should be a classification of anesthetic depth that will help the anesthetist to decide not only how deep the anesthesia is but also whether the depth is optimal.

Factors Influencing Depth of Anesthesia

Depth of anesthesia varies directly with the dose of anesthetic agent and inversely with the intensity of surgical stimulation. The greater the quantity or concentration of anesthetic administered, the deeper the anesthetic depth. The greater the amount of surgical stimulation, the lighter the anesthetic depth.

The change in intensity of stimulation is greatest at the time the operative procedure begins, when there is a transition from almost no stimulus to one that is rather intense. All anesthetists are familiar with the patient who appears to be in surgical anesthesia but who reacts violently when the incision is made. Other examples of a sudden increase in stimulation may be mentioned: when periosteum is stripped from the ribs; when the rectum is dilated; when traction is exerted upon abdominal viscera; when an instrument is inserted into the trachea.

The reverse of this situation is seen when the operation is completed. The patient is often in such light anesthesia that he moves about and moans during closure of the skin. As soon as the last suture is placed, the patient lapses into a state of relatively deeper anesthesia, during which airway control may be difficult, and unconsciousness may continue for a prolonged period. In this situation the quantity of anesthetic drug remaining within the patient is relatively small, but anesthesia is deeper because the stimulus has been removed.

A mathematic analogy may be drawn: The dose of anesthetic drug represents a plus value. The degree of surgical stimulation rep-

resents a minus value. Depth of anesthesia represents a summation of the plus and the minus value.

Method of Study

Recordings of the respiratory pattern during anesthesia may be made by means of a simple device. The flow of gas from the anesthesia apparatus is directed into the inlet of a Benedict-Roth basal metabolism apparatus. The spirometer of the basal metabolic rate machine substitutes for the breathing bag of the anesthesia machine. Any anesthetic agent may be administered. The written record gives visual evidence of the respiratory pattern.

New Classification of Depth

At Ohio State University we have developed a system of depth classification that we find beginners in anesthesia can easily understand and apply. Most experienced anesthetists with whom we have discussed it say that they have actually been employing this method of judging depth without realizing that it constitutes a new classification. The classification provides a criterion by which the anesthetist is able to judge fine changes in depth of anesthesia, not in accordance with a numerical system, but in accordance with the moment-to-moment progress of the surgical procedure. We have attempted to organize and to standardize a portion of "the art of anesthesia."

In this classification, anesthetic depth in combined anesthesia is divided into three categories: *too light, too deep,* and *just right.*

Anesthesia that is *too light* is indicated by an alteration in the breathing pattern that consists of frequent deep breaths or breath holding, usually accompanied by an increase in rate of respiration. As the discrepancy between depth of anesthesia and degree of surgical stimulus increases, with the anesthesia much too light, the respiration becomes grossly irregular; shallow breaths, deep breaths, and breath holding occur with no relationship to each other. If the anesthesia is very much too light, there may also be movement of the extremities, wrinkling of the forehead, turning of the head, coughing, swallowing, and vomiting.

Anesthesia that is *too deep* is indicated by perfectly even, shallow breathing with no evidence of any irregularity. As the depth increases, there will be tracheal tug, intercostal paralysis, and pupillary dilatation.

Anesthesia that is *just right* is indicated by the fact that the patient has regular respiration, each breath identical with the preceding and the following breath. The excursion of respiration is as great as is consistent with satisfactory relaxation. In order to be certain that the depth of anesthesia does not insidiously increase, the patient should be allowed to exhibit a slight sign of light anesthesia from time to time. The regular pattern of respiration should be interrupted every few minutes by a deeper breath or a slight pause.

The use of muscle-paralyzing agents modifies the respiratory pattern in that the excursion of respiration is decreased, but the rhythm and regularity are not appreciably altered.

Technic of Management

Induction of anesthesia is accomplished in the customary manner, with the use of either an intravenous or an inhalation agent. When the respiration becomes regular, surgical stimulation may begin. It will sometimes be found that the respiratory pattern will immediately become grossly irregular, particularly if pentothal sodium is the principal anesthetic agent. Additional anesthetic should be administered until the rhythm again becomes regular. A muscle-paralyzing agent should be administered in an amount sufficient to cause a slight decrease in the excursion of respiration. This will usually create satisfactory relaxation for an abdominal procedure.

When the peritoneum is opened, the respiration may again become slightly irregular, and the surgeon may say that the patient is "pushing" or that the patient is "tight"; this calls for the administration of additional anesthetic agent. When respiration is again regular, the "pushing" and "tightness" usually disappear. However, if additional relaxation is required, it should be obtained by the administration of a small additional dose of muscle-paralyzing agent.

When the exploration of the abdomen is completed and the surgeon begins the definite work of the operation, the degree of surgical stimulation is usually diminished. For this reason, the administration of anesthetic agents should be discontinued, since the anesthesia now becomes *too deep*. The anesthesia should be lightened until slight irregularities in the respiratory pattern are again noted. If surgical stimulation again increases, usually as a result of traction on viscera or mesentery, the irregularities in respiration become more frequent and pronounced, and additional anesthetic agent is called for. If muscle tightness again develops during the course of a long procedure, additional muscle-relaxing agent is used.

Previously mixed solutions of a barbiturate and a muscle-relaxing agent ordinarily are not used. It is more satisfactory to use separate solutions of the drugs and to administer each one in accordance with the need of the patient.

Depression of respiration is produced both by muscle-relaxing drugs and by anesthetic drugs. If the need for relaxation is such that the combination of drugs causes severe depression, the respiration should be assisted by manual pressure on the rebreathing bag.

Respiratory obstruction may cause the respiration to become shallow or irregular or both. The inexperienced anesthetist may become confused and interpret the shallow respiration as *too deep* and the irregular respiration as *too light*. Respiratory obstruction, being in itself the most harmful complication of anesthesia, must not be allowed to occur.

Usefulness

We have found that this system for classification of depth of anesthesia is particularly valuable as a teaching device.

The most important application of this classification is in those procedures that require the anesthetist to be at some distance from the patient, such as in intra-

cranial, face, and head and neck operations. In many of these instances intubation is performed and the patient is covered by drapes, so that the anesthetist can see nothing at all but the operative field. If the blood in the wound becomes dark, it is an indication that something is seriously wrong with the patient. But this should never occur, and for this reason observation of the blood is of little value as a control device. Changes in blood pressure and pulse may be of some value, but, again, these changes are late rather than early. With the anesthetist seated some six or eight feet away from the patient, the control of depth of anesthesia may most easily be accomplished by very close observation of the rebreathing bag.

During laparotomy the anesthetist is easily able to determine whether the depth of anesthesia is satisfactory, and he is able to maintain consistently good relaxation with a minimum of anesthetic agent. On the other hand, he can avoid the administration of excessive doses of muscle-relaxing agents when more anesthetic drug is really needed.

Summary

1. The use of several drugs—narcotics, sedatives, and anesthetic agents—makes it difficult to determine the anesthetic state of the patient.

2. A standard for depth of anesthesia is formulated, in which there are three principal categories: (1) *too light*—irregular rhythm of respiration; (2) *too deep*—completely regular respiration with decreased excursion; (3) *just right*—regular respiration with an occasional slight pause or an occasional deeper breath.

3. The need for a muscle-relaxing agent is distinguished from the need for additional anesthetic agent.

4. The various phases of a surgical procedure produce alterations in anesthetic requirement. This classification of anesthetic depth facilitates moment-to-moment control.

Disaster Anesthesia

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In the event of an atomic attack on an American city the work of all medical personnel will be multiplied many fold, and that of the anesthetists is certainly no exception. By necessity, this work will have to be done with a minimum of equipment and under the most adverse circumstances, resulting in conditions much worse than those on the battlefront. In battle there usually is an adequate supply of trained personnel as well as adequate supplies and equipment; this cannot be expected under disaster conditions. Personnel, supplies, and equipment can be equally short. At times things that we may be forced to do may even seem ruthless; for example, it may be that we will have to pass by the hopelessly wounded victims in order that the salvageable may be saved. We will certainly have to use agents and methods of administration other than those we would like to use, because the time and equipment just won't be available for more than the absolute essentials. In fact, only enough will be available to do the bare necessities, if one prepares and then energetically conserves supplies.

Mental adjustment and planning prior to such a possible emergency will enable us to perform at maximal efficiency under these conditions. Even though we may work or live in a city far removed from what we may consider a probable target, we may be called upon to go to such a stricken area to aid in the work there. Or it may be that casualties from disaster areas will be evacuated to us from distant areas.

Fantastic numbers of wounded may be expected with any such attack. It has been estimated that if the city of Chicago were the target of an atomic attack there is a possibility that there would be 330,000 nonfatal casualties. This huge number of patients would present a tremendous problem even if working conditions were ideal and supplies of both personnel and equipment were adequate. It is highly probable that all public utilities would be affected to some degree. This includes gas, electricity, water, and transportation. Imagine, if you can for a moment, a hospital without gas, without electricity for lighting, to operate elevators, sterilizers, roent-

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gen equipment, suction machines, and so forth. The water supply may be unusable even if the mains are still intact. And how will the physicians, nurses, attendants, and other personnel reach the hospital if buses and streetcars cannot run and streets are impassable to automobiles? We must consider this and more if we are to be of help under such conditions. It is almost certain that some hospitals would be completely demolished and many members of the staff killed or injured so severely as to be of no help in the care of others.

Not only would victims of the disaster by the thousands be streaming into the hospitals for emergency treatment, but the usual emergencies such as acute abdominal conditions and obstetric cases would continue unabated. In the event of such an emergency it will be necessary to utilize every facility at our disposal. Preparedness, by previous analysis of needs, and ingenuity can be the factors responsible for saving countless lives.

Because of the probability of so many patients, some persons normally not anesthetists, such as medical students, dentists, and others, are being trained to administer open drop ether and start blood transfusions and infusions of plasma and other intravenous fluids, as well as to help with general first aid work. It will be the responsibility of those who have had more extensive training and experience in anesthesia to supervise these "emergency anesthetists" as well as to administer anesthesia to the poorest risk patients. It will probably be necessary to distribute trained personnel throughout the community, to scatter them, so they may be of the greatest help to the greatest number.

It would be wise for each of us to consider what equipment and supplies we have on hand and how we can best put them to work in case of a disaster. Is there an old anesthesia machine that is no longer used in the hospital but that could be put into working condition and ready for use if needed? Is there an adequate stockpile of anesthetic drugs and supplies on hand to care for disaster patients? What does the hospital have on hand in the way of blood, plasma, albumin, and plasma expanders, such as gelatin solution, fluids, dextran, or polyvinylpyrrolidone? Now is the time to consider these things and to prepare for an emergency.

It will be necessary under disaster conditions to use all the agents and equipment that we have available; consideration of each of these and a decision as to which to use, and when, will be of great help should the demand arise. It is of the utmost importance, however, that no fixed notions be had; flexibility and ingenuity are the factors that will save lives, as long as one does not forget good principles of anesthesia. In good risk patients slight deviation from these principles may not result in disaster, but in poor risk patients these principles must be strictly adhered to at all times or lives will be needlessly lost.

Types of Injuries

It would be well to consider the main types of cases that would result from an atomic explosion. These can be classed under five groups.

Blast injuries.—Under this head comes shock from the tremendous force of the explosion as well as pulmonary edema from the blast and multiple pulmonary hematomata and ecchymoses. Pulmonary edema, preventing as it does the free passage of gases through the alveolar membrane, presents a great challenge to the anesthetist under the best of conditions; if possible, operations in such cases should be carried out under regional anesthesia. The use of positive pressure apparatus is helpful in correcting the edema, and it may be necessary to use oxygen under positive pressure even if the surgeon uses local anesthesia. If available, it will be better to use the regular positive pressure apparatus than an anesthesia machine so that the anesthetic equipment can be kept free for administration of anesthesia to patients for whom local methods of anesthesia are not practicable.

Radiation injuries.—This second type of injury is the immediate reaction to severe radiation exposure and resembles any burn in its early manifestations. These patients may be expected to be in a state of shock; the technics of anesthesia used should therefore be the ones indicated for a patient in shock. The later reactions of the body to radiation are not of special concern to the anesthetist in the immediate disaster period.

Traumatic injuries.—Falling debris and flying glass will cause lacerations, contusions, and fractures just as any explosion would. These will often be multiple, and many of them will be around the face and neck, because these areas are the most exposed. If at all possible, the surgeon should be urged to treat these patients under adequate local or field block anesthesia. The use of intravenous anesthetics in cases of head and face injury is especially hazardous, because adequate protection of the airway is almost impossible, and the use of a mask is prohibited by the area involved. Intratracheal anesthesia will, of course, enable us to administer a safe general anesthetic to these patients, but too many of them would probably present themselves to permit it except under occasional circumstances. One must beware of intracranial injuries in cases involving the head. If these patients are given drugs that will further increase the intracranial pressure, the results may be disastrous to the patient. Any agent that causes respiratory depression in such patients is also hazardous. Because of these factors, one should use utmost caution in administering morphine, demerol, and barbiturates, as well as general anesthetics.

Hysteria.—Hysteria will be present to some degree in almost all of the injured. It may be so slight as to require no treatment or so severe as to call for energetic therapy. The drugs of choice here are the bromides, chloral hydrate, paraldehyde, and the barbiturates. The dose will depend on the severity of the symptoms and upon the coincidental findings of shock, trauma, hemorrhage, and the like. It should be emphasized that nervousness and restlessness may be manifestations of cerebral hypoxia or shock. Therefore, caution should be used, since these drugs, and primarily the barbiturates, may potentiate shock or convert

incipient shock into frank shock. The "old-fashioned" drugs, such as the bromides, paraldehyde, and chloral hydrate, are worth remembering, as they are relatively safe. They can be given in varying combinations, and they can be administered by various routes.

Mixed injuries.—This group will include most of the cases. It will comprise large numbers of patients with any two or more of the aforementioned types of injuries. During the war in the "blitz" on London, the importance of careful inspection for multiple types of trauma was quickly learned. A patient may have burns with lacerations, hysteria, or internal injuries. One should, too, always suspect the possibility of trauma or pathologic states that are not on the record. For example, a burned patient may also have diabetes, hypertension, renal or thyrotoxic disease; or a patient with a broken arm may have tension pneumothorax. The possible combinations are legion. Careful inspection and alertness are always necessary with this type of patient.

Shock

One of the big problems that face the anesthetist in any severely traumatized patient is shock, and among the victims of an atomic disaster there will certainly be many patients in true or incipient shock. One should immediately suspect shock when a patient is discovered to have hypotension (which may be relative), a fast thready pulse, cold moist skin, poor color, and dyspnea. In the case of incipient shock the picture is not always so clear. These patients are able, to a degree, to compensate for the trauma and usually show a relatively normal blood pressure; however, the other signs of shock may be present, especially the fast thready pulse and the cold clammy skin. Although such patients seem to be in fair condition, anything that will upset their compensating mechanism will cause them to go into true shock, which may become irreversible. For example, should such a patient be given ether anesthesia, with its accompanying vasodilatation, true shock may supervene, a condition from which the patient may not recover. He has already used most, if not all, of his compensatory reserves. Hence, one should make every effort to correct both incipient and true shock before administering an anesthetic to any patient.

We must combat shock in all patients with the proper agents whenever they are available. Patients suffering from blood loss should have blood. Burned patients or those in shock from blast injuries should have blood or plasma. The use of narcotics to relieve pain may help prevent shock; however, large doses given to shocked patients may aggravate the condition. Judgment is necessary. When narcotics are given, they must be administered intravenously for reasons to be discussed later. Patients should be kept warm enough to prevent loss of body heat but not so warm as to cause sweating with the resultant loss of body fluids. To protect the vital centers, oxygen should be administered to patients in shock whenever possible.

Unfortunately, what the patient should have and what is available may not always be the same, es-

pecially under disaster conditions. It is in those circumstances that the plasma expanders are so valuable. They are retained in the circulation longer than ordinary fluids for intravenous administration, such as glucose in water, some of them remaining for several days. They maintain the circulating volume of blood, and although they are not utilized by the body, they perform the important function of filling the dilated vascular tree of a shocked patient; this in turn improves cardiac function. However, as the plasma expanders draw fluid from the tissues into the blood stream, care should be taken not to give too much too fast, or the blood pressure may rise to dangerous heights; this may lead to cardiac failure.

In the absence of these agents, or until they can be obtained, 5 per cent glucose in distilled water, which will temporarily increase the blood pressure in many cases, can be given to most patients in large amounts, as it is readily eliminated from the body. Administration of saline solutions to atomic disaster patients should be kept to a minimum, because many will have or will get pulmonary edema from the blast, and saline solutions will aggravate the problem.

Vasopressors should be used only if there is no other method of fighting shock, for their action is of short duration. They are merely a temporary crutch to tide the patient over until more definite therapy can be instituted and fluids, blood, or other agents procured. Here, as in most problems with respect to anesthesia, good judgment will save lives.

Preanesthetic Medication

The premedication of these patients will be a problem different from that usually seen in routine patients. Many of them will have had morphine in relatively large doses before being brought to the hospital, and this dosage should be taken into consideration before giving the patient any additional narcotic. Many of these patients will have poor circulation, and if the agents are administered by the usual subcutaneous route, they may not be absorbed into the general circulation until the anesthesia is half over or until the patient is resuscitated and brought out of shock. Various sedative or hypnotic drugs may have to be substituted for morphine; or these drugs may have to be omitted altogether if the supply is short. Atropine or scopolamine should be given in the usual dosage. Any premedication given should be administered intravenously if at all possible. If the agents are given intravenously fifteen minutes before the anesthesia is to be started, they will exert the maximal effect when they are needed most, that is, during the induction. Preanesthetic medication is especially important when the anesthetist is inadequately trained. The "disaster anesthetist" will have more trouble with secretions, vomiting, and reflexes than the adequately trained person who is better able to cope with such situations.

Types of Agents

It will be necessary for the surgeons to perform ***local or nerve block anesthesia*** whenever possible. This will facilitate the speed

with which patients can be treated and will also conserve the supplies and personnel for general anesthesia where they are mandatory. Procaine is a cheap and effective drug that can be stored indefinitely in dry form ready to mix with water or saline. It requires little space and little equipment, is portable and nonexplosive, and can be prepared quickly. Every operating room should have an adequate supply of this invaluable agent available for any disaster condition.

Ether and oxygen in a closed system will probably be the anesthetic of choice in most of the cases where trained personnel is available. If carefully given in a closed system, an ounce of ether will be sufficient for most cases, and the oxygen used will be minimal. There are probably fewer contraindications to this agent than to any other that is sufficiently potent for most work. It is a cheap agent, and high oxygen concentrations are possible. Although induction with ether-oxygen is rarely done because it is slower than that with many of the other agents, it can be done if the ether concentration is built up very slowly.

Ether and air by the open drop method will probably be used in most cases because it is the simplest technic available and has a very wide margin of safety. Even a relatively inexperienced anesthetist can give ether by this method relatively satisfactorily. Anesthesia machines may be at a premium, but ether masks can be improvised from tea strainers, coat hangers, and other odd materials without great difficulty.

Cyclopropane is a fast-acting pleasant agent but will no doubt be in short supply and difficult to obtain; therefore, its use will probably have to be restricted to induction and certainly should be employed only by those who are thoroughly trained in its use. It has a depressant effect on respiration and imparts a false sense of security by maintaining the blood pressure and keeping the pulse rate slow until the patient has emerged from anesthesia, after which his true condition becomes apparent, and he may go precipitously into shock.

Pentothal sodium, although an apparently simple drug to administer, can be extremely hazardous for patients who are inadequately prepared, especially when given by a person who is not expert in the administration of the agent. Patients in shock or in incipient shock are especially vulnerable to collapse when this agent is used. Many of the patients who will be treated under such emergency conditions will have a full stomach, and the regurgitation of retained gastric contents may easily lead to severe laryngospasm; or the material vomited may be aspirated and cause severe pulmonary complications or death from asphyxia. Pentothal sodium may be the ideal agent to control hysteric patients who must be treated surgically, the barbiturate being augmented with either general or local anesthesia.

Nitrous oxide and ethylene when used alone will probably not be adequate for this type of emergency work. Where they are used, they should be administered in a closed system to conserve the gases. The relatively small percentage of oxygen that can be given with them is a disadvantage. Supplemented with ether or as

agents for induction of anesthesia, these gases may, however, play a valuable role should disaster strike.

It should be borne in mind that cyclopropane, ethylene, and ether are explosive agents, and that much of the disaster work will be done in improvised locations. Adequate ventilation and the avoidance of open flames near the site of anesthesia should be ensured to prevent disastrous anesthetic explosions.

Rectal anesthetics, such as avertin, are too time consuming in preparation and unless given in dangerous doses are inadequate without supplementation. If alternative agents are available, rectal anesthetics should not be used.

Spinal anesthetics are mentioned here only to condemn them for routine disaster work except when given by experts and then only for selected cases, chiefly for injuries of the lower extremities. Because of the blocking of the sympathetic nerves and the marked muscular relaxation, there tends to be a decrease in blood pressure. This may be fatal in true or in incipient shock.

Curare, through its muscle-relaxing powers, may also cause a profound decrease in blood pressure, and because it may cause respiratory arrest, it should never be given by anyone not completely familiar with its action and then only if means for adequate artificial ventilation and for intratracheal intubation are at hand.

Postoperative Care

The postoperative care of the disaster patient is even more important than that of the patient undergoing an elective operation. Every patient should be placed on his side until he is completely awake in order to minimize the possibility of aspiration of secretions or vomitus. Fluid administration started prior to operation should not be discontinued until it is certain that shock will not supervene, as this would render the restarting of intravenous infusions most difficult. If possible, suction machines and oxygen should be available for use on these patients.

Minimum Requirements

The following is a list of items that we consider minimal requirements to be at hand. A number of these can be improvised, and some suggestions are given; however, there are many more ways in which such improvisations can be carried out, and it is surprising how few basic materials may be needed for them.

Open drop ether: Cans of diethyl ether; safety pin (put through top of can, it will provide a dripper in the absence of cork and wick); mask (this may be improvised from any pieces of wire, such as a coat hanger); a length of rubber tubing (this may serve as a nasopharyngeal airway, intratracheal tube, suction catheter, stomach tube, tourniquet, etc.); gauze to cover mask (this may be replaced by any other cloth such as from a handkerchief or shirt); gauze on a stick (to serve as a mouth swab); atropine (for minimal premedication); syringe and needle.

Resuscitation: Oxygen; rubber tubing for nasal administration of oxygen; blood, plasma, and/or plasma expanders; 5 per cent dextrose in water; intravenous sets (one set may have to serve for many consecutive cases); needles; alcohol sponges; adhesive tape. Positive pressure oxygen may be improvised by use of a bag and mask with rubber tubing from a to-and-fro machine.

Local anesthesia: Syringe, needles, alcohol sponges, and procaine solution are all that are required for this type of anesthesia.

The above are minimal requirements, and if additional supplies of drugs and equipment are available, so much the better. They may conveniently be reserved for special cases. Economy in the use of all that is at hand is of the utmost importance, as even these minimal requirements constitute a formidable list under the circumstances then prevailing.

The quantities of such agents as blood, plasma, and plasma expanders that would be needed are truly tremendous if one considers the amount of these agents needed in civilian practice for one single badly burned individual. The task of making them available in case of a disaster is an enormous one, and therefore the plasma expanders and simple electrolyte solutions are the only ones that will be available in any amount, as they may be stored indefinitely.

SUMMARY

In writing this article it is fervently hoped that the time spent is wasted—that an atomic bomb never falls on America—but if such disaster should occur, it is best to be prepared. The best preparation that we can make for such an emergency is a mental one. We must organize our thinking as to what we can do to be ready. We must stockpile agents and equipment, and organize personnel against such an eventuality. We must realize that conditions will be far from ideal, but we must make the best use of our ingenuity and the equipment that we have available.

The employment of *good fundamental principles* of anesthesia cannot be neglected for even a second under disaster conditions. Adequate oxygenation, maintenance of a good airway, and continuous observation of the patient are even more essential, if this is possible, in anesthetizing disaster patients than in our daily work.

Radioactive Isotopes in Medicine

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Prior to 1935 the accomplishment of ionizing radiation tissue was through the known sources of x-rays, radium, and the daughter elements of radium. Since that time radioactive isotopes have been added to the armamentarium of the medical researcher and clinician. Studies with radioactive materials are applied daily to problems concerning metabolism, conversion, absorption, and growth processes. The use of radioactive isotopes in the field of industrial and medical research has provided such a stimulus to the individual investigator that textbooks covering the physiology and metabolism in normal and diseased states are outmoded before they are published.

Today there are diagnostic problems possible of solution because of various isotopes, prepared as a chemical substance, that can be detected by special instruments. The amount used, however, is so minute as to render harmful reactions highly improbable.

An isotope that is to be used for medical purposes must meet specific requirements that are determined by the Atomic Energy Commission. The isotope must have a half life that is predictable and short lived. There can be no impurities or formation of harmful ionizing daughter substances. The isotope must not lodge or concentrate in areas not to be treated. The radioactive isotope has thus become another safe diagnostic instrument in the field of science.

More than fifty-five years have elapsed since radioactivity was discovered. Yet today our knowledge of the structure of the atom is at best meager. Approximately ten years ago the first artificially produced radioactive isotopes were used for medical purposes. Investigation was naturally limited owing to the expense and difficulty involved in obtaining the isotope. With the advent of the atom bomb and the establishment of the Atomic Energy Commission's program, the increased use of isotopes became feasible.

Isotope: Structure

An atom consists of a nucleus, which may contain two types of particles, namely, protons and neutrons. The nucleus is surrounded by whirling bodies called electrons, which are negatively charged. The neutrons are electrically neutral. Thus the

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*From the Adolph Kraft Foundation Isotope Laboratory.

nucleus is positively charged. The positive charge of the protons neutralizes the negative charge of the revolving electrons, thus rendering the atom neutral.

The nucleus itself occupies approximately a thousandth of the total space of the entire atom; however, the mass of the atom is practically all concentrated within the nucleus. The nucleus (mass), which contains the neutrons and protons, weighs approximately 1,840 times as much as the negatively charged electron. As atoms are electrically neutral, it is therefore necessary that the total number of electrons equal the number of positively charged protons.

Every known element has its own individual number of protons. Each element, from hydrogen, the lightest known element, to uranium 92, the heaviest known natural element, contains a specific number of protons and electrons.

The nucleus of each known element after hydrogen has a specific number of neutrons. The total number of protons, or total number of positive electrical charges, gives the individual atom its number. Thus hydrogen with one proton is $_1H$—the subscript to the left is the atomic number. The hydrogen nucleus does not contain any neutrons. Thus the superscript on the right indicates the atomic weight—one proton plus 0 neutrons equals atomic weight of 1. Deuterium is expressed H^2, meaning that it has with its nucleus one proton plus one neutron. Uranium is written $_{92}U^{238}$. It can then be determined that uranium contains 92 protons and 146 neutrons and could be expressed 92 protons and U 92 protons plus 146 neutrons.

The chemical properties of each element are dependent upon the structure of the atom. Each individual element between H and $_{92}U^{238}$ possesses its own specific number of protons and electrons and consequently exhibits its own particular chemical properties.

The loss of a proton from the nucleus of an atom also causes the loss of an electron, which in turn results in the formation of an atom the next lowest on the atomic table. When this change occurs, the chemical properties of the atom are also altered. Adding a proton to the structure of the atom will result in the addition of an electron to the orbit. This phenomenon results in the stepping up of the atom on the atomic table. This process is known as transmutation. Subtraction of a neutron also reduces atomic weight, but it does not change the number of electrons or protons. This change in atomic weight does not alter the specific chemical properties, and therefore the atom remains in its original position on the atomic table. Atoms that possess identical chemical properties but have different atomic weights are known as isotopes.

Isotope: Production

The production of isotopes is accomplished by bombarding atoms with particles from other atoms. These particles are derived from the nucleus of the atom and may be protons, neutrons, or combinations of proton and neutron—such as alpha particles, beta particles, or a deuteron. An alpha particle consists of two neutrons and two protons and possesses a

positive charge of two. A deuteron consists of one neutron and proton and consequently carries a positive charge of one. A beta particle is a body that is carrying the negative charge of the neutron, and when explosion of the negative body occurs, it continues to hold a negative charge. The neutron passes over to a proton with a positive charge of one. The bombarding particle or agent upon contacting the bombarded element may (1) remain in the nucleus or (2) continue on and pass through and may or may not expel some portion of the nucleus. If the bombarding particle contacts the target atom and does not pass through without altering the structure, a new atom is formed. The resultant product, the newly formed atom, may be either stable or unstable and disintegrate immediately. Disintegration occurs in all atoms: some require many millions of years; others disintegrate over a measurable period of time.

For each individual element with specific conditions present, characteristic decay changes will occur. Disintegration, or decay, occurs according to the degree of stability of the atom. Thus an atom by undergoing disintegration becomes stable. This process of disintegration causes the ejection of some nuclear particles, such as alpha particles or beta particles. A gamma ray may also be emitted as a result of internal rearrangement of the neutrons and protons. These particles that are ejected in the process of disintegration are classified as radioactive particles.

Isotopes are produced either naturally or artificially. Isotopes, when they occur spontaneously, are the result of the bombardment of radioactive elements in ores. The same process is utilized in the cyclotron. Today, for the most part, the supply of isotopes is from the Atomic Energy Commission stock pile. This process is basically the utilization of neutron bombardment within the uranium piles.

Quantitative Determination

The measurement, or quantitative determination, of the isotope is accomplished by various methods depending upon the presence or absence of radioactivity.

Isotopes that are stable are measured in a spectograph. The radioactive isotopes are measured by the use of a Geiger-Müller counter. This instrument consists of a tube that registers the number of explosions per unit time. This tube in turn is attached to a scaler that records the number of explosions. It is the radioactive isotope that, when used in any minute amounts, is easily detected by various electronic instruments.

Radioactive isotopes may contain alpha rays, beta rays, or gamma rays. The alpha particle in the atom has an approximate range of a few millimeters. At that point its energy is expended. Radioactive isotopes that emit alpha rays are for the most part highly toxic and are bone seekers. These isotopes are not too useful and have a half life that is usually quite long. An example of an alpha emitter would be plutonium. Isotopes emitting beta rays have particles that penetrate from 1 mm. to several centimeters. These rays are the most useful and the least toxic. The radioactive isotopes emitting beta rays are used

for diagnostic procedures and therapy more than are the other isotopes possessing different physical properties.

The range of the gamma ray is in feet, and the ray itself cannot be localized in a prescribed area.

The goal in utilizing the radioactive isotope is to deliver the prescribed, predetermined amount of radiation to a specified area (tumor, organ) without injuring surrounding tissue. It is desired that the isotope be concentrated in the specific pathologic cell group indicated and thus emit radiation that could be entirely absorbed by the offending cells. That, of course, is the goal of the researcher.

Radioactive Phosphorus (P^{32})

Phosphorus (P^{32}) has a half life of 14.2 days. (In 14.2 days one half of the P^{32} will have disintegrated, or decayed, and within a period of 60 days or so practically all detectable radioactivity will have disappeared.) This isotope concentrates to a degree in the erythrocytes, spleen, bone marrow, liver, and rapidly growing tissues. It is odorless, colorless, and tasteless and is prepared from the fission products of the Oak Ridge Reactors. Phosphorus (P^{32}) administered orally is absorbed rapidly from the gastrointestinal tract, and approximately 30 per cent is excreted in the stool during the first 4 days. P^{32} is probably the preferred treatment in polycythemia and chronic leukemia.[1,2] Complete hematologic and symptomatic remissions can be produced with P^{32} in most cases of polycythemia. In patients with myeloid leukemia who had been treated with P^{32}, Lawrence and others[3] reported a significant prolongation of life.

Other investigators[4] showed a definite increase in the life span in patients having lymphatic leukemia treated with P^{32}. Phosphorus (P^{32}) is also used for the determination of the circulating blood volume. From these determinations the cell volume hemoglobin can be found, and appropriate replacement therapy can be effectively instituted. In addition to the aforementioned uses of P^{32} the isotope can be employed successfully to determine circulation time and efficiency.[5]

Radioactive phosphorus (P^{32}) is used extensively by many investigators concerned with metabolic studies. This very important element is a constituent of phospholipids and nucleoproteins. Nucleoproteins are found to be concentrated in those cells possessing high or increased activity. P^{32} is being used to study the mechanisms of these tissue reactions.

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Iodine (I^{131})

Iodine (I^{131}) is thought by many workers to have the greatest therapeutic and diagnostic value. Radioactive iodine (I^{131}) has a half life of 8 days and has emissions of beta rays (0.595 m.e.v.) and gamma rays (0.367 m.e.v. and 0.080 m.e.v.). This combination of properties makes this isotope very desirable.

I^{131} has made it possible to study the physiology of the thyroid gland with a thoroughness that was previously not possible. By the use of this radioactive isotope considerable information pertaining to the function of the thyroid gland has been accumulated.[6]

It is now known that the rate of deposition of I^{131} is decreased in hypothyroidism and increased in hyperthyroidism.

By the use of tracer doses it can be demonstrated that normal individuals concentrate 15 to 20 per cent of the radioactive isotope in 24 hours, while hyperthyroid individuals concentrate over 40 per cent and hypothyroid individuals below 15 per cent.

Many cases of altered basal metabolic rates do not show a correlating variation in the rate of iodine uptake. Thus the tracer test is of considerable importance. I^{131} has been used in the treatment of Graves' disease for about nine years, and in general more and more I^{131} is being used in the treatment of hyperthyroidism.[7]

The ease of administration, lack of complications, and end results are factors justifying its increased use.

I^{131} used alone or as diiodofluorescein will exhibit selective concentration in brain tumors.[8] This detection is possible owing to the presence of the gamma rays, which can be readily counted. The accuracy of this procedure has been attested to by Davis and his associates[9] who reported diagnosing central nervous system tumors in 200 patients with 95.5 per cent accuracy. Other investigators substantiate the accuracy of other brain-tracing technics.

Radioactive Sodium (Na^{24})

This isotope has been used to determine the volume of extracellular fluid and has been employed in the study of shock. It has been useful in the study of blood flow rates in various types of individuals and diseases.[10]

Radioactive Iron (Fe^{55} and Fe^{59})

These two radioactive isotopes of iron have been used to study the physiology of the erythrocyte. The use of these isotopes makes it possible to study the red cell under normal and abnormal conditions.[11,12]

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12. Gibson, J. G., II, and others: Measurement of circulating red cell volume by means of two radioactive isotopes of iron. J. Clin. Investigation **25**:616-626, July 1946.

Radioactive Strontium (Sr^{89})

This radioactive isotope is a chemical analogue of calcium. It has a half life of 55 days. It has been used to irradiate osteogenic sarcoma and bone metastases from cancer of the prostate. Sr^{89} has a high selectivity for bone and has been used to study bone metabolism.[13, 14]

Radioactive Cobalt (Co^{60})

This radioactive isotope has a half life of 5 years. It is used in the forms of beads, needles, and bombs. It is being used experimentally at this time, and its value will become known as further studies are undertaken.

13. Pecher, Charles: Biological investigations with radioactive calcium and strontium. Preliminary report on the use of radioactive strontium in the treatment of metastatic bone cancer. Univ. California Pub., Pharmacology (no. 11) **2**:117-149, 1942.

14. Treadwell, A. DeG.; Low-Beer, B. V. A.; Friedell, H. L., and Lawrence, J. H.: Metabolic studies on neoplasm of bones with the aid of radioactive strontium. Am. J. M. Sc. **204**:521-530, Oct. 1942.

Summary

Radioactive isotopes too numerous to mention are being used to study the physiology of animal and plant life. Among these carbon, sulphur, and gold are important, but space does not permit further discussion of the increasing scope of this subject.

In general, it can be stated that those isotopes that display the greatest predilection for the specific tissue desired radiated have the most therapeutic value. At this time I^{131} and P^{32} are the most important. The application of isotopes to the study of the basic sciences has resulted in a greater understanding of pathologic conditions. As time permits, many radioactive compounds will be investigated and added to the list of useful isotopes.

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Cerebral Damage from Anoxia during Childbirth

Clement A. Smith, M.D.*
Boston

The subject assigned to me is one concerning which there has been much testimony but very little satisfactory evidence. For example, we have testimony to the fact of cerebral damage after neonatal or fetal anoxia but insufficient evidence to state the frequency with which anoxia during childbirth results in such damage. Therefore, I suggest we look at what facts we have, next look at the testimony available and consider its status as evidence, and finally see if we can come to any useful conclusions especially applicable to your work as anesthetists.

We can begin with one fact. Anoxia in childbirth *must* be capable of causing cerebral damage because, if sufficiently prolonged, it kills babies. The timetable of such an unfortunate event is of interest. The infant, as an organism, does not die all at once. The medulla seems to die before the heart, for the fetus who has suffered a complete interruption of oxygen supply because of placental separation or cord compression is often born with a dead medulla (as shown by failure of any respiratory movement) but a heart that is still beating. It is also evident that certain other parts of the brain, such as the cerebral cortex or the basal ganglia, may die before the medulla—that is, they may suffer permanent damage from which they never recover. If this happens, and the anoxia is relieved while the medulla and heart are still alive, the result will be a living infant with an impaired intellectual or neuromuscular status.

A second consideration that can be accepted as a fact is that anoxia does not kill fetal or newborn mammals so quickly as it kills adult ones. No one has shown any more conclusively than Dr. Snyder[1] that young animals have a strikingly longer survival than adults under anoxic circumstances. I believe the same differences occur in fetal and newborn human mammals, though not perhaps to such a great degree. If we did not have some such protection as a species, the race might perhaps have died out through inability to get its members born.

Read before the Nineteenth Annual Meeting of the American Association of Nurse Anesthetists, Philadelphia, Sept. 18, 1952.

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1. Glass, H. G.; Snyder, F. F., and Webster, E.: Rate of decline in resistance to anoxia. Am. J. Physiol. **140**: 609, 1944.

This leads us to the highly practical question of *how long* a human fetus or newborn infant can withstand anoxia both by remaining alive *and* by remaining normal and undamaged. Here we leave facts behind and argue only from scattered observations, since the matter of course cannot be put to any test. Most data from clinical observation are, moreover, subject to three troublesome qualifications interfering with their use as evidence. The first of these is that the only period of anoxia we can be at all accurate in timing is that which elapses after the infant is delivered so that we can see him. If he is not breathing at all, we can assume that he was anoxic from the moment of birth, and becoming more so, until the beginning of breathing terminates the interval. But since we never can tell the duration of the *intrauterine* anoxic status that may have preceded the event of birth, we can't say at all certainly how long a time the *whole* anoxic interval lasted. A second variable is the degree of anoxia. For instance, unless we have repeated samples of arterial blood or a constant and calibrated oximeter reading, we have no accurate way of knowing whether baby A and baby B (both cyanotic and apneic) have the same debased amount or tension of oxygen in their blood and tissues. Actually baby A may perhaps be only half as anoxic as baby B. Finally, since circulation of blood to the brain is not a constant factor in all infants, it is possible to have two infants, both with equal degrees of anoxemia, in one of whom a poor circulation is delivering only half as much of the meager store of oxygen to the brain as in the other. The limitations of clinical observations as scientific evidence are thus discouragingly great.

Some people of greater experience than I have put all usable testimony together and made rough calculations, which are as reliable as any information available. At a week-long conference on anoxia of the newborn held in London, a group of experts came to the guarded conclusion that, in the presence of a reasonably good circulation, the newborn infant will suffer permanent anoxic damage to the cerebral cortex if he fails to breathe or otherwise to take in any oxygen for a period of from twenty to forty minutes. Even the medullary cells must be irreparably damaged and unrecoverable (that is to say, dead) after forty minutes without breathing, if not before. This is, as we have reiterated, disappointingly vague, but we have no better information.

When we drop this somewhat academic approach and look at clinical studies from large groups of patients, we also find problems in evaluating evidence. The simplest approach is to examine the histories of children with obvious clinical or pathologic brain damage and find out how many of them were anoxic at birth. This, of course, tells us nothing about the number of anoxic newborns who are *not* permanently damaged. The results of such studies usually work out about as did a recent one by Belknap, McKhann, and Beck[2] in Cleveland. These authors found that about half of some 400 children brought to them with fixed brain damage or

2. Belknap, W. D.; McKhann, C. F., and Beck, C. S.: Cerebral birth injury in retrospect. J. Pediat. **37**: 326, 1950.

defect gave histories suggesting birth injury. But they found it impossible to say in how many of these the injury was a direct physical trauma with predominance of hemorrhage and in how many it was pure anoxia. The trouble is—obviously—that a 5 year old child with idiocy or convulsions may have an inadequate brain because he was apneic, cyanotic, and anoxic at birth, or he may have been apneic, cyanotic, and anoxic at birth because he was born with an inadequate brain or a physically traumatized one. Thus, all we can say from such retrospective studies is that birth and neonatal histories that imply a period of anoxia do occur with suspicious frequency in the backgrounds of children who develop badly. Which one of these is cause and which one is effect is not known with certainty in every such case.

The more useful approach is to turn the procedure around and follow a group of newborn infants in whom anoxia has quite clearly occurred during or after birth, and in whom *no other* potentially harmful factor—such as physical trauma or infection—has occurred. This is, of course, a much more difficult and expensive type of research, but its results are more specific and vastly preferable for prognostic use.

Not many such studies have been done, and if I describe the two most recently published ones you will see why. Campbell and his colleagues[3] in Belfast went through the records of 6,000 live births that occurred in 1938-41 inclusive and picked out all infants who did *not* have such conditions as congenital malformations, hereditary disorders, and intracranial hemorrhages but *did* have failure to breathe for at least two minutes after birth. There were 89 such infants. They also picked out 178 normal controls born at the same time but breathing at once. A quite good sample (61 and 134 of the two groups, respectively) was located eight to eleven years later and examined by mental and physical tests. The asphyxia group and the control group were similar in all respects of later development, *except* that of the asphyxiated infants two were mentally defective and one was both mentally defective and athetoid. The authors were still unwilling to believe that these three children out of 61 turned out badly *because* of the early apnea. Perhaps they are right, but their opinion cannot be proved.

A similar study by Usdin and Weil[4] was concerned with the present intelligence of 90 infants born twelve to fourteen years ago at the Cincinnati General Hospital and failing to breathe for at least three minutes after birth, and of 90 prompt-breathing controls. In order to be quite sure they were measuring the effects of anoxia alone, Usdin and Weil included only those infants who were slow to breathe at birth and who were not premature or delivered by section, showed no abnormal neurologic signs at birth or at their later examinations, had no diagnosis or suspicion of intracranial hemorrhage, and no evidence of hereditary or congenital disease. One might assume that with such rigid selection all 90

3. Campbell, W. A. B.; Cheeseman, E. A., and Kilpatrick, A. W.: Effects of neonatal asphyxia on physical and mental development. Arch. Dis. Childhood **25**: 351, 1951.

4. Usdin, G. L., and Weil, M. L.: Effect of apnea neonatorum on intellectual development. Pediatrics **9**: 387, 1952.

infants chosen would of course be normal when re-examined twelve years later. However, all 90 had in common the fact that they did not breathe for at least three minutes after birth, and the purpose of the study was to learn whether this period of anoxia in any way impaired their later intelligence. Forty-three of the 90 anoxic infants and 45 of their 90 non-anoxic controls were located twelve to fourteen years later. All of both groups were satisfactory children. The average intelligence of those who had been anoxic at birth was actually somewhat greater than that of the control group. One infant who had not breathed for as long as ten minutes after birth had an intelligence quotient of 105 at age 14. Moreover, the two highest intelligence quotients among all children—those who were anoxic and those who were not—were those of two who had not breathed for five minutes after their birth.

What does all of this mean? Surely not that neonatal anoxia promotes intelligence, nor that every infant apneic for ten minutes after birth will develop as satisfactorily as the one just mentioned. It does mean that one must follow hundreds (if not thousands) of moderately anoxic infants in order to determine how large is the small percentage that will turn out badly. In other words, although many intellectually subnormal children appear to have been anoxic at birth, relatively few anoxic newborn infants turn out to be intellectually damaged children. This should not allow any relaxation of effort to prevent anoxia before, during, or after birth. It should not make us any more than relatively complacent about the use of agents, such as those used for obstetric anesthesia, that may delay onset of breathing at birth. It should certainly not allow us to be at all complacent about the *mis*use of any such agent. We cannot say that five minutes of postnatal apnea is entirely safe for all infants. Nor can we say that every infant who does not breathe for five minutes will grow up to be feebleminded or paralyzed or convulsive. I think we can say that if obstetric anesthetics benefit the mother and infant (as I believe they may) the benefits of their proper use probably outweigh the slight accompanying risks.

Clinical observations allow us to make certain further statements regarding hazards in the relief of pain in childbirth. Such observations, as well as common sense, indicate that the risk of anoxia entailed by the use of obstetric anesthesia is least when the obstetric situation entails no other risk. In the uncomplicated vertex delivery of a full-term infant after normal pregnancy and labor, the likelihood of harm from properly used maternal analgesia and anesthesia is extremely small. But in the presence of one or more complicating factors, such as prematurity, breech delivery, prolonged labor, maternal toxemia or diabetes, or fetal distress, the possibility of harm from anesthesia becomes predictably greater.

A second clinical consideration is that the safety of any analgesic or anesthetic preparation depends more upon the skill and experience of the person using it than upon any inherent properties of the agent itself. We have been so thoroughly indoctrinated against the evils of morphine in my own

hospital that I was at first shocked when I learned of its continued use in some other hospitals. It appears to me now that those obstetricians who have had decades of experience with the use of morphine are probably as successful and as safe with it as are our own group with the barbiturate derivatives.

One other clinical observation is related to the place of anesthesia among the various agents that produce fetal or neonatal anoxia. In general, fetal anoxia and neonatal apnea (which produces anoxia) can result from three causes: (1) *trauma* to the lifeline, which begins at the uterus and continues through the placenta, cord, and brain; (2) *previous anoxia* resulting in chemical damage to the central nervous system so that apnea and further anoxia occur; and (3) the anoxic or narcotic effects of *analgesia* and *anesthesia*. My colleagues in pediatrics and I feel that anoxia or apnea caused by the third group of agents is by far the easiest to deal with and has the best immediate and later prognosis. If the only unusual finding in an infant breathing poorly is a strong smell of ether arising from his crib, we usually breathe a sigh of relief. If, on the other hand, he was delivered under no anesthesia at all or under local block anesthesia (which is almost the same thing) but has a history of fetal distress resulting from premature separation of the placenta or has clinical evidence of intracranial injury, we worry about him. If he has not only evidence of intrauterine anoxia or birth injury but also a strong smell of ether, we worry about him even more.

SUMMARY

In spite of many gaps in our knowledge (especially as to its safe limits of degree and duration), neonatal anoxia is a threat to the survival and to the intelligence of infants and children. In the aspect that most concerns anesthetists, the threat need not be an alarming one. As with every other agent used in medicine, anesthesia is a two-edged sword. Properly used, it can and does fight for the mother and her infant.

A. A. N. A.

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Reduction of Morbidity and Mortality in Obstetric Anesthesia

A Forum

Newlin F. Paxson, M.D.,* Franklin F. Synder, M.D.,†
Clement A. Smith, M.D.,‡ August Groeschel, M.D., §
Victoria Scullen, R.N.,‖ and Mary A. Costello, R.N.¶

Dr. Paxson: The subject of obstetric analgesia and anesthesia is important in a consideration of the reduction of maternal mortality. As the three great external causes of death during childbirth—hemorrhage, sepsis, and toxemia—have gradually been brought under control, the less common causes assume greater importance. This particularly is true of obstetric analgesia and anesthesia.

It is not that the science of anesthesia has failed to progress, because it has. It is simply that we are now more conscious of its importance and dangers. If these dangers are so great that we should discuss them at a meeting, one might say, "Let us forego obstetric analgesia and anesthesia to reduce the pain during labor." That would be a step backward, first, simply because the use of analgesia and anesthesia is humane and, second—and this is a point often omitted in these discussions—it shortens labor and makes it safer. Owing to the fact that with analgesia the first stage of labor usually progresses more rapidly than without analgesia, there are fewer operations for delivery with the head at the level of the midpelvis or near the inlet. Of course, there are a greater number of operations for delivery at the outlet, but surgery can be used much more safely for delivery there than higher in the pelvis. Therefore, by having fewer operations in the midpelvis there are fewer risks for mother and child. Likewise, during labor there are fewer cases of exhaustion due to prolonged suffering without pain relief and rest. Consequently, the reason for using anesthesia and

Panel discussion before the Nineteenth Annual Meeting of the American Association of Nurse Anesthetists, Philadelphia, Sept. 15, 1952.

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analgesia is more than humaneness, although that alone is important.

On the other hand, relief of the pain of childbirth has dangers and if mishandled may cause death or damage to mother or child. For example, in Philadelphia in 1951 there were about 32 maternal deaths; in 2 anesthesia was one of the important factors, which is a mortality rate of 6 per cent of the fatal cases. When we come to consider injury to the fetus and the newborn the percentage of damage and death is considerably higher. This gives us an idea of the importance of the problem that we bring under discussion today.

Actually, obstetric analgesia and anesthesia, like the automobile, are not an unmixed blessing. Certainly, we wouldn't live without the automobile in this country for what it has to offer in convenience in transportation. Yet the automobile is one of the great causes of death of human beings in the United States. We also wouldn't live without analgesia, but we recognize its dangers. This is exactly the reason why meetings such as this are held. If we have sufficient skills, we may eliminate the dangers, just as safe drivers of automobiles do not have accidents.

The essentials of the problem are few, although they become quite intricate: First is the selection of the agent or agents, both for analgesia and anesthesia, and the proper time in the administration of these agents during labor. Second is the matter of the technical skills required for the administration of both analgesia and anesthesia, so that neither mother nor child may be damaged. Third is the problem of management of the patient as a whole while under the effects of analgesia and anesthesia.

Dr. Groeschel: In the area of administration it would appear that there are several problems related to obstetric anesthesia, and all of them appear on investigation to lead to one conclusion: Only in exceptional situations has obstetric anesthesia been organized and supported to the point where every obstetric patient is routinely assured of the services of a qualified, trained anesthesiologist or anesthetist during delivery.

The factors underlying this condition are numerous and interrelated, and the relative importance of each of them varies from hospital to hospital.

Perhaps the basic factor accounting for much of the failure of hospitals generally to insure the services of a trained anesthesiologist or anesthetist to every patient during delivery is the relative unpredictability of the need for any anesthesia or a specific kind of anesthesia in many obstetric cases and the almost complete unpredictability of the date and time of the anticipated need, if any.

As the father of five children, I mention this factor of unpredictability with considerable feeling and from the vantage point of some minimal personal observation.

This factor of unpredictability in obstetric anesthesia is in almost direct contrast to the almost complete predictability of the need in surgery, where, with the exception of emergencies, the extent and character of the need can be predicted to a very large degree well in advance of the date and time of the need.

In the presence of the unpredictable need in obstetric anesthesia, usually an effort is made to provide a sufficient number of trained anesthesiologists and anesthetists to take care of the average volume of cases. As a result, when peak loads occur, in contrast to the average volume of activity, as they do with unmonotonous irregularity, relatively untrained persons are pressed into service to "pour ether." These persons may be attending physicians, students, or interns whose training in anesthesia and whose knowledge of the problems of obstetric anesthesia may be very limited or nonexistent. Nurses, attendants, or medical students may be pressed into service. The end result, in terms of insuring the safety of the mother and the baby, is many times something less than that desired.

Measures calculated to offset the problems posed as a result of the unpredictability of the need for anesthesia or a specific kind of anesthesia are inevitably tied up administratively with considerations of economy. It is obviously uneconomical to provide and support continuously on a standby basis a staff of qualified, trained anesthesiologists and anesthetists adequate to handle peak loads. Unfortunately, in some hospitals this is used to justify the maintenance of a trained staff adequate to meet only the minimal case load.

It would appear that the only policy justifiable from the standpoint of both the patient's safety and care and a sound and economical administration is to insure continuously a staff of trained people adequate to handle the average—and I emphasize the average—case load as far as this can be calculated, and to provide special training for an adequate number of those persons—house officers, attending physicians, and obstetric nurses—whose services may be required when peak loads occur.

This special training of such persons should be placed on a formal basis, with required attendance, demonstrations, and supervised on-the-job training, so to speak, of a definite character and extent, so that at all times there will be available to support the efforts of the trained anesthesiologists and anesthetists a corps of trained persons capable of administering safely and correctly anesthesia to patients in labor.

Let me emphasize once again the need for putting this training on a formal basis, with regularly scheduled instruction and mandatory attendance, and all under the supervision of a trained and qualified chief anesthesiologist or anesthetist and with the assistance and cooperation of the chief obstetrician, whose responsibility in this area is separate but unmistakably clear.

The administrator's responsibility for seeing to it that the regular trained anesthesia staff is adequate to meet the demands of the average case load rather than the minimum case load is equally clear. In this area demonstrated unjustifiable economy that results in injury to the mother or baby certainly lays the hospital open to charges of administrative negligence, and under certain circumstances might even lead to charges of criminal negligence, in my opinion.

The second factor accounting for much of the failure of hospitals generally to insure the services of a trained anesthesiologist or anesthetist to every patient during delivery is traceable to a feeling on the part of many physicians, obstetricians, and others, that almost anyone can safely "pour ether" or "give gas," to most obstetric patients during delivery. As a result, many physicians and obstetricians appear to accept the fact of anesthesia being administered in what appear to be uncomplicated obstetric cases by untrained people, including physicians, as a necessary evil or deficiency. This situation can be improved and this deficiency can be corrected only by the education of physicians and others concerned to the importance of anesthesia in obstetrics. This education is going on all the time, and the writers and experts in the field reflect growing awareness and concern for the need for greater realization of the importance of anesthesia in obstetrics by physicians and hospitals.

Illustrative of this educational effort is the forthcoming textbook on obstetrics which is currently being completed by Dr. R. Gordon Douglas, professor of obstetrics and gynecology at Cornell University Medical College and obstetrician and gynecologist-in-chief at the New York Hospital. Dr. Douglas has kindly permitted me to study the original unedited manuscript from which I would like to quote the following, which is contained in the chapter tentatively titled "Anesthesia and Analgesia." I am quoting from Dr. Douglas' new book:

> During recent years there has been an increasing awareness of the importance of anesthesia in obstetrical practice. Formerly the custom prevailed rather generally of delegating this responsibility to junior members of the resident staff or, in some instances, to relatively inexperienced nurses. Fortunately, this practice has been largely discontinued. . . .

(In this respect I cannot agree with Dr. Douglas, I am afraid.)

> Fortunately, this practice has been largely discontinued, and all services that may be classified as being well equipped and well conducted have a staff of qualified and trained anesthetists. Preferably such individuals should be doctors of medicine trained in the art of anesthesia. However, because there is not a sufficient number of such trained personnel, it is necessary to utilize the services of nurse anesthetists. These individuals when properly trained become expert technicians capable of administering satisfactory and safe anesthesia and also of carrying out procedures such as passing a bronchoscope and aspirating vomitus.

(I might mention here that all of the anesthesia administered on Dr. Douglas' service is administered by nurse anesthetists, and I might add that the service has averaged something like 4,800 or 5,000 deliveries

a year for the past number of years, and I don't believe he has had an anesthetic death in some years, which is a tribute to nurse anesthetists.)

Anesthesia in obstetrical practice is complicated by a number of situations that make it mandatory that this responsibility can only be entrusted to well trained and experienced individuals. Enumeration of these factors follows:

1. Anesthesia is often required after a labor that has resulted in fatigue, acidosis, dehydration, etc.
2. By unfortunate coincidence anesthesia may be indicated a short time after the ingestion of solid food or when the stomach for other reasons is not empty.
3. Emergencies will arise when it is imperative that delivery be accomplished at once without appropriate preparation.
4. The respiratory exchange is often unavoidably limited.
5. Light anesthesia utilizing the force of uterine contractions is desirable at times, while on other occasions more profound anesthesia to relax the uterus becomes necessary.
6. Various medications may have been employed during labor, which must necessarily be taken into consideration.
7. Emotionally the patient is often in an unsatisfactory condition for anesthesia.
8. Until the time of delivery of the infant, the anesthetist administers the anesthesia to both the mother and baby but must estimate the degree of anesthesia of the latter by the clinical signs in the former.

The great importance of anesthesia in cesarean section is exemplified in an investigation by Gordon of deaths following this operation in Brooklyn from 1937-1950. He found that 20 per cent of 242 deaths were caused directly by anesthesia. The following data indicate the type of anesthesia or agent employed, and the ascribed cause of death:

There were a total of 21 deaths from spinal anesthesia in this series of 242, of which 9 were due to atelectasis, none to aspiration, and 12 labeled as toxic.

With the nitrous oxide plus oxygen plus ether, there were a total of 17 deaths, of which 8 were due to atelectasis, and 8 due to aspiration, and 1 labeled toxic.

With ether alone there were 6 deaths, 4 due to atelectasis, 2 to aspiration, and none toxic.

Other combined forms formed a group of 4 deaths, with 4 due to atelectasis, none to aspiration, and none toxic.

A total of 48 deaths out of 242 were due to anesthesia.

This report emphasizes the necessity for having expertly trained personnel for the administration of anesthesia to the obstetrical patient.

I would like to quote further from a passage later in this chapter by Dr. Douglas:

General Anesthesia: There is inevitably some inherent danger associated with the administration of any anesthetic agent. Certain statistical data and the opinions of many well qualified obstetricians and anesthetists indicate that ether may be the safest agent and spinal the most dangerous method currently employed. There are many factors that must be taken into consideration before selecting the agent or procedure to be employed for any given patient. The careful selection of the proper method is, of course, most important. The success of any given plan is dependent to a large extent on the training and ability of the anesthetist. The services of an expert trained in the art of obstetrical anesthesiology is essential for the best results in the administration of these agents. Any compromise in this respect is fraught with danger, and experience has indicated the relative frequency with which fatal accidents may occur when untrained personnel have assumed this responsibility. Mortality studies by maternal welfare committees in different parts of this country have done much to bring this situation to our attention during the past two decades, and as a result of improvements that have been instituted deaths directly and indirectly attributable to anesthesia have been greatly reduced.

The anesthetist must at all times be cognizant of the amount of anesthetic agents and oxygen that are passing through the placenta into the fetal circulation. He should also be familiar with the obstetrical history and medications that the patient may have received during the first stage of labor and the time interval since the last ingestion of food or fluids. For the greatest degree of safety the anesthesia, delivery, and operating rooms should be constructed in such a way as to eliminate the possibility of static or other electric sparks. This implies attention to matters such as electric outlets, switches, conductive flooring, temperature, relative humidity, etc. Further precautions to obviate this hazard consist in the use of cotton clothing for all personnel and practices designed to avoid the possibility of an explosion. Apparatus and personnel should be available to clear the respiratory passages and maintain artificial respirations, if necessary, in both the mother and baby.

Dr. Douglas makes another statement at the conclusion of the chapter on anesthesia and analgesia that I feel I would like to include here:

We are enthusiastic in our support and encouragement of the woman who is anxious to avoid analgesics and anesthetic agents during a normal labor, and we are in complete agreement that the physical health of the mother and baby may best be protected by this means. At the same time we are equally certain that she should at least have some relief from pain when requested. Constant attendance on the part of trained personnel will decrease the amount of drugs used. When the occasion demands, however, it is imperative that skilled anesthetists be available. Under no circumstances can we condone the practice of insisting on spontaneous delivery to avoid the use of anesthetics when an easy and simple operative procedure will give improved maternal and fetal results. The judicious use and careful selection of sedatives, analgesic agents, and anesthetics usually makes it possible to conduct labor with a reasonable degree of pain relief. Operative deliveries, when indicated, may be conducted under similar judicious use of anesthetics safely and painlessly with a decrease in maternal morbidity and increased fetal survival rate.

With medical schools and textbooks stressing the need for trained personnel for the administration of anesthesia in obstetrics, and with obstetricians and general physicians generally tending to realize the importance of anesthesia in obstetrics, it is reasonable to expect that the improper attitude "anybody can do it" should eventually be corrected.

In this connection, in my opinion, the administrator of the hospital is not the last person who should be re-educated. The responsibility for educating the administrator to the realization that the administration of obstetric anesthesia by trained personnel is a must for his hospital lies largely in the hands of the obstetrician, with an assist from the pediatrician. Obstetric anesthesia will generally be no better than the obstetricians demand.

A third factor of importance is the organization of anesthesia service in the hospital. In this connection I refer to those hospitals wherein the organization for providing anesthesia for obstetric service is separate and distinct from that providing all other anesthesia services in the hospital.

There are many difficulties inherent in such an addition of authority and responsibility for anesthesia services, and all of them are re-

flected in the quality of anesthesia service rendered to obstetric patients. It is difficult enough to secure an adequate number of trained anesthesiologists and anesthetists to begin with. The extent of the shortage of trained personnel generally and the difficulties of recruitment are well known to all of us, but these are small, indeed, by comparison with the difficulties of recruiting and retaining trained personnel for a completely separate obstetric anesthesia service.

Many anesthesiologists and anesthetists will acknowledge that they assiduously avoid working in a separate obstetric anesthesia service for a variety of reasons. Many of them think that with the exception of an occasional difficult case it offers little to challenge the competency of the anesthetists. Others succumb to the general attitude we mentioned a little while ago that "anyone can do it," and, therefore, it offers little distinction and prestige to the trained person as an exclusive career or specialty. Others say that the calls are too unpredictable in matter of time, and that as a result hospitals insist upon long "on call" hours, which are restrictive and understandably unpopular.

In terms of over-all skilled supervision, quality of service, flexibility, and capacity to meet the peak loads, I believe there is no question but that the ideal organization of anesthesia services in the hospital provides for a single department under a single responsible chief.

The fourth factor which we would like to mention is the shortage of trained personnel. We have referred previously to the well known shortage of trained personnel as one of the most important factors underlying problems of providing skilled anesthesia services to obstetric patients. I think it is hardly necessary for me to enlarge upon this subject which is well known to all of you.

Suffice it to say that the number of trained anesthesiologists and trained nurse anesthetists presently available for obstetric service falls far short of the demand, and the outlook for the foreseeable future is no more reassuring. The further development and expansion of residency training programs in anesthesiology must be encouraged. Similarly, the further development of programs for the training of nurse anesthetists in schools maintaining acceptable standards must be stepped up.

I would like to interpolate here that the effort of the American Association of Nurse Anesthetists in the matter of developing standards for schools of anesthesia and promoting these standards is a highly creditable effort in this area.

The need for trained personnel is real and important, and it must be met if hospitals are to provide to obstetric patients the safety and assistance which modern medicine now provides.

In conclusion, I would like to mention that I have attempted to outline briefly some four main factors which I believe to a large degree

underlie current administrative problems involved in the provision of obstetric anesthesia. They are by no means all of the factors involved. However, I believe that they are significant and that they deserve your attention and that they should be included in any discussion of the extremely important subject of obstetric anesthesia.

Dr. Paxson: In obstetric analgesia and anesthesia the analgesia may very often be administered by the attending physician and the anesthesia completed by a trained expert in that field, so that it is a two person job, instead of the entire management of the case being under a single person.

I am going to ask Dr. Snyder who should have the responsibility for the selection of the anesthetic agent during labor. Dr. Snyder, how would you assign the responsibility for picking the anesthetic agent?

Dr. Snyder: The session this afternoon is a result of a co-operative effort on the part of the anesthetist, the obstetrician, and the pediatrician. In any given instance the obstetrician may well have several methods to suggest, and on the basis of experience the anesthetist, the person who is actually carrying out the anesthesia, may cast the deciding vote. As to the ideal anesthetic agent for obstetrics, we are still in the stage of having to deal with many factors at the same time. I think that the procedure at the moment is a matter for consultation between the obstetrician and the anesthetists who are present, and I would certainly also be in favor of having the pediatrician give us his opinion on the after-effects.

Dr. Paxson: In our hospital the obstetricians select the analgesia to be given in the first portion of labor. When it comes to the question of anesthesia, there is usually a conference with the anesthetist and anesthesiologist, their opinions perhaps bearing the major weight.

Miss Costello, who selects the analgesia at the Cincinnati General Hospital?

Miss Costello: It is selected by the anesthetist and by the residents on the obstetric service.

Dr. Paxson: For instance, if you are using a barbiturate, does the anesthesia staff select the type of barbiturate and determine the dose and the time it is to be administered?

Miss Costello: No, this is done by our resident obstetrician. We try to make some suggestions with respect to choice of anesthesia. We feel that there can be no general rule made with respect to the choice of anesthesia and that it depends upon the condition of the patient. For instance, if we have a patient for premature delivery or with a respiratory tract infection, that patient usually receives saddle block anesthesia. A patient who has had some food in the past seven hours usually receives saddle block anesthesia.

Dr. Paxson: Do you precede the administration of saddle block

anesthesia with other types of drugs, that is, analgesics, such as barbiturates and demerol?

Miss Costello: That's right.

Dr. Paxson: But that is controlled by your obstetric resident?

Miss Costello: Yes, by the obstetric resident who orders the barbiturate usually with demerol.

Dr. Paxson: A very important part of the management of labor, as Grantly Dick Read of England has written, is the development of confidence, the control of fear, and teaching the patient to relax. Perhaps one of the most important questions is who is responsible for the psychologic preparation of the patient. Miss Scullen, how is the psychologic management of the patient handled at the Hospital of the University of Pennsylvania?

Miss Scullen: Most of the obstetricians prepare their patients beforehand, but some of them don't, and it is our responsibility to see that the patient is properly prepared. The main problem is fear. We have special nurses for every patient, and the patient relaxes, knowing that there is somebody in the room with her. However, most of the obstetricians prepare their patients beforehand.

Dr. Paxson: We feel that it is the physician's responsibility to prepare the patient psychologically for the experience of a strange hospital and labor. As Miss Scullen has pointed out, most—but not all—of the obstetricians do prepare the patients in that manner. In addition the continuous attention of special nurses is given all patients during labor, not only for the psychologic preparation but also for the protection and welfare of the patient.

I'd like to ask a question on the resuscitation of the newborn, which occasionally is a problem in every institution. Apparently different hospitals have different procedures. In some the anesthetist may perform the resuscitation; in some the obstetricians; in some the pediatricians. We find varied knowledge of and skill in resuscitation, and I am going to turn to Dr. Smith for the answer to this question, for part of his study has been in evaluating the resuscitation of the newborn.

Dr. Smith, how would you evaluate resuscitation? Would you care to assign the responsibility for it to any particular group?

Dr. Smith: I think the best way to do a great many of these things is to have conferences at which the pathologist, the anesthetist, the obstetrician, and the pediatrician discuss their failures, which occur in every hospital. The sessions should be held regularly with everybody present, with no holds barred, and with full opportunity for a very free and frank discussion of all the facts.

Every Friday afternoon a meeting is held at which all the stillborn and liveborn babies who are neonatal deaths in that particular week are discussed. We get a good deal of co-operation from all con-

cerned, and we have very little, if any, complaint to make of the procedures used.

At our hospital our obstetric colleagues resuscitate most of the babies that are resuscitated in the delivery room. They often arrive at the nursery and need more or subsequent resuscitation.

I think the best method of resuscitating a baby is the method that the youngest member of the staff can use with safety to the baby on New Year's Eve at about three o'clock in the morning, when there is nobody around to give him a hand, and when he has to do something that is often fraught with danger.

Also because we have not yet a program under way whereby we have a man skilled in the use of a bronchoscope or laryngoscope in constant attendance in our hospital, we don't use them. We don't want an instrument lying around the wards that someone will pick up without knowing how to use it and become slightly "trigger happy."

We have not yet had the opportunity to use the Bloxsom air lock. From what we have seen and heard about it we are not certain how it can do very much more, if anything, than oxygen given in an ordinary tent or bassinet or incubator, except for the fact that it has the distinct advantage of keeping the baby separate from the doctor, which may often be quite a good thing.

We have come back to a Kreiselman machine as the simplest and safest way of getting oxygen to an infant. Oxygen is about the only thing with which you can hope to wake up a dying or a sick baby. We do feel that no respiratory stimulant has any known advantages, and we seldom, if ever, use one. Of course, the preparation Dr. Snyder discussed this afternoon, which I believe will be marketed under the name of "Naline," has a specific advantage in cases in which depression is induced by the use of morphine.

I would sum up by saying that a decision arrived at in regular conferences as to the simplest and safest type of equipment, the familiarizing of everybody who may be around the delivery room with that piece of equipment so that he can use it safely, and then the discussion of every failure are much more important than the use of any single specific apparatus that I know.

Dr. Paxson: The types of analgesia and anesthesia that may be used during childbirth may be roughly divided into three groups: the inhalation methods (chloroform, ether, cyclopropane, ethylene, etc.); the oral and parenteral methods (morphine, barbiturates, and synthetic analgesics, such as demerol) followed by deeper anesthesia for delivery; and the regional and local methods.

Of course, it is generally well known that drugs administered by inhalation, parenteral, and oral means donate their quota to the baby's respiratory system, but that drugs given by local and regional methods do not, since none of the latter drugs passes the placental barrier.

The question is whether there has been any change in the frequency of use of regional and local methods of analgesia and anesthesia for delivery. We are going to ask Miss Costello of the Cincinnati General Hospital first what they think of those procedures out in Cincinnati.

Miss Costello: We administer quite a few saddle block and low spinal anesthesias, and these are usually our first choices for anesthesia. These are administered by a nurse anesthetist.

The second choice of anesthesia is usually drop ether, and God bless drop ether! We have fewer deaths from drop ether, I feel, than from any other agent. Because a baby is born and it doesn't smell like procaine, saddle block anesthesia is never blamed for a mortality that we see, but let them smell one drop of ether on a baby's breath, and right away that's the answer to that baby's death.

The third choice is usually some type of intravenous anesthesia. Experimental work that we have been doing shows that by cord analysis as much pentothal sodium and surital sodium as is in the mother reaches the infant in approximately five minutes.

Dr. Paxson: Dr. Snyder, how do you and your group of workers feel about regional and local methods of analgesia and anesthesia?

Dr. Snyder: At the moment, the increase in popularity seems to be on the part of interns and their supervisors in perfecting the technic in local infiltration. Of course, they are perfectly aware of the responsibility. As Dr. Smith said, whenever possible, encourage them. That may extend as far as the special teamwork necessary to perform cesarean sections under infiltration anesthesia.

By implication, I suppose that means that with respect to the hazards for the mother, many doubts have been raised about the use of spinal anesthesia in obstetrics, and as the observations have increased, it has been noted that the child does not by any means escape the danger of anoxia by the administration of spinal anesthesia to the mother.

The whole matter, of course, is controversial. I should think that the trend at the moment is towards the perfection and extension of the use of infiltration technics rather than towards the utilization of the spinal canal with all the hazards, although that doesn't imply that extending the study and the use of spinal anesthesia isn't of the utmost importance; I am only speaking of the trend.

With respect to intravenous anesthesia, all the agents that have been used have been shown to be harmful to the fetus. If anything, the fetus is more sensitive to respiratory depression than the mother. So there is no encouragement for extending the use of intravenous anesthesia as far as protecting the child is concerned.

One new point is that a drug that has been on the shelf for many years, *n*-allyl normorphine, seems to be an antidote to the depressant effects of morphine and demerol. However, that doesn't mean that it abolishes the anoxia. It takes away the effects of morphine itself, but

the effects of the anoxia may remain.

In the sense of change, I should think that at the moment analgesia has changed more than anesthesia.

Dr. Paxson: Incidentally, does Naline have any effect on the barbiturates?

Dr. Snyder: It has no effect on them whatever. It seems to be a peculiar substance. It is a morphine derivative that no one would think of as having any particular interest, and that, as a matter of accidental observation, was found to preempt the place of morphine. Apparently, the cell would rather use *n*-allyl normorphine and disgorge the ordinary morphine.

Dr. Paxson: An important problem, although perhaps not a great deal of mention has been made of it, is the problem of the patient who comes in with a full stomach, having just eaten a meal, in active labor. More important, perhaps, is the problem of nourishing the patient who has a fairly long labor in a hospital. I am going to ask Miss Scullen how the nutrition of patients in labor is handled at the Hospital of the University of Pennsylvania.

Miss Scullen: When a patient goes into labor, food is restricted, and we give a liquid diet consisting of orange juice and water up to one hour before delivery.

Dr. Paxson: Do the physicians administer some form of analgesia and leave the patient under the direction of the nursing staff in your hospital, or is the patient under the constant supervision of the physicians?

Miss Scullen: The patients are under the constant supervision of our resident physician.

Dr. Paxson: We find in surveying practices in the United States as a whole that there have been hospitals in which the physician has managed the analgesia by telephone, the patient receiving the dose of analgesic at the hospital, the physician being at his office, and the nurse having the responsibility for calling him in time to deliver the baby without interfering with his office hours. Occasionally, this can lead to certain difficulties, disasters, and complications.

Another big problem is that the residents having graduate training in obstetrics and gynecology have a tendency to feel that the baby is a byproduct of their work and to turn the baby over to the pediatricians as soon as the baby is born or born and resuscitated.

My own feeling is that we have an obligation to pay attention to that baby and to work in complete co-operation with the pediatrician. In the Hahnemann Hospital, in actual practice, the newborn baby nursery and the premature nursery are under the direction of the pediatric staff, but we still try to insist that the obstetrician understand and know about the problems of the newborn baby. I would like to ask Dr. Smith whether he feels that the baby should be turned over com-

pletely to the pediatrician as soon as delivery and resuscitation have been accomplished, and whether the obstetrician and perhaps the anesthetist should want to stop in the nursery and follow their babies.

Dr. Smith: I think, to be fairly brief about it, that we are all in this together, and it doesn't seem to me that there is any certain moment where the baby stops being a fetus and becomes my patient and no longer yours. I am just as interested in him during the prenatal life as I know you are, and I think all your colleagues ought to be interested in postnatal life. The person who handles the very important element of anesthesia is in there, too.

I don't see any legally limited liability clauses that you can write into any contract, and I don't think there ought to be a contract. People who need contracts to do these things can't live together very smoothly with the contract, and people who live together pretty well never need a contract. We are all interested in babies, and we pediatricians are getting more and more interested in their mothers. And, thank goodness, in our institution that interest seems to be welcome, and we heartily welcome interest from the other side.

It seems to me, as I go around the country, that the same feeling is on the increase everywhere, and I think we are going to see these artificial delimitations break down very rapidly.

Dr. Paxson: Another problem is the question of judgment in selecting the anesthetic agent. Dr. Snyder, suppose there is a woman at term who is hemorrhaging acutely as a result of placenta praevia and probably will need a cesarean section. The question is what anesthetic would you select?

Dr. Snyder: I think Dr. Paxson will bear me out that hemorrhage is the primary matter. Once that has been taken into consideration and the matter of anesthesia comes up, you are up against the old question, is there an ideal anesthetic in obstetrics? All the factors, including who is available to give it and so forth, enter into this.

For many years we delivered such patients by joint sections with local infiltration anesthesia with very good results. However, there are many other angles to it, and by no means is that a final answer.

Dr. Paxson: Our procedure worked out in co-operation with the anesthesia department is to use spinal anesthesia in a case of acute hemorrhage, unless it is contraindicated because of the danger or actual presence of a decrease in blood pressure. If we are not in a rush, we use local infiltration anesthesia. If we are in a hurry, we use very simple anesthesia; the anesthesia department usually gives ether or an ether-oxygen mixture, and we try to work as rapidly as possible.

I would like to make a few comments about the findings of the Maternal Mortality Committee in Philadelphia that impress me and are part of the problem of obstetric anesthesia and analgesia. First, if the blood pressure decreases to below 80 mm. Hg systolic for five

minutes or longer, the newborn baby will suffer from anoxia due to depression of the central nervous system. The blood pressure may be decreased from shock and hemorrhage, true, but it may also be decreased from spinal anesthesia that accidentally has ascended higher than is desired, and all anesthetists should keep that fact in mind. The one big drawback to spinal anesthesia is that if it accidentally ascends too high a severe decrease in blood pressure occurs and one has anoxia in the newborn. The same is true of a severe decrease in blood pressure from a procaine reaction.

However, that is not the most important anesthetic accident that we see. A common procedure, at least through the 1930's, was the use of barbiturates prescribed by the attending physician and nitrous oxide and oxygen for delivery. This combination caused a number of deaths in Philadelphia from an effect that apparently has not been described adequately, namely, the piling of hypoxia on hypoxia or anoxia on anoxia. The patient receives a barbiturate or a synthetic analgesic such as demerol, and moderate respiratory depression develops. She is brought to the delivery room for routine forceps delivery with normal episiotomy, or perhaps a more difficult operation is indicated. The anesthetist gives nitrous oxide and oxygen, and as far as I have been able to observe in my limited travels the technic is something like this:

The works that you have read say that 100 per cent nitrous oxide with no oxygen is administered followed immediately by a number of breaths of 90 per cent nitrous oxide and 10 per cent oxygen, or the technic may be to start with 90 per cent nitrous oxide and 10 per cent oxygen, which theoretically, according to all the teachings, is only given for a few breaths. But in actual practice, as I have observed it, this mixture will be given for five minutes and sometimes longer. Then gradually the mixture is changed until we reach what Dr. Snyder has shown to be the basic minimum of 15 per cent oxygen and 85 per cent nitrous oxide.

By that time the obstetrician asks for ether, and perhaps the mixture will be changed gradually to a safer combination, but during this time the anesthetist and obstetrician may see the patient die, die just as suddenly as if the cause were an embolus. The Maternal Mortality Committee has heard, time after time, the explanation that the only thing that could have happened so suddenly was the formation of an embolus, and the patient died, and the obstetrician and the anesthetist weren't responsible for the accident. But the autopsy, when one is done, does not bear this out. The studies have shown that actually the anoxia caused by the analgesic plus the anoxia of anesthesia for actual delivery does occasionally cause such a sudden death in the mother and, I am sure, accounts for a higher percentage of accidents in newborn babies.

Dr. Smith: It is really something of a misfortune to come from a hospital where the anesthesia service is as good as it is in ours and not to have sat in, as you have, on maternal mortality studies, because these things, of course, could happen. But in good hands there is nothing in the agents listed that should account for such accidents.

Dr. Snyder: I have noted the difference between the effect on the fetus of morphine itself and of a low oxygen mixture. We can separate those effects under experimental conditions. All of the analgesics, such as morphine, the barbiturates, and demerol, have been shown to depress activity, more or less, especially in the nervous system. The central point of the depression is that the use of oxygen is impaired. The factor of anoxia in narcosis is pretty well recognized, and a fetus may stop breathing, for instance, if it is depressed, so that you can not tell whether he had been depressed before receiving the barbiturate or whether he had been depressed as a result of oxygen want.

However, if you only produce a small amount of hypoxia and a small amount of narcosis, you can tell which is which clinically. The narcotic effect is one of sleepiness. You can arouse that child, but he will fall back into a sleepy condition. Anoxia is more or less one way: Once he surrenders to an anoxic depression, he doesn't come back. I have found that fact useful in examining newborn infants, and I think it is a perfectly obvious situation. The most to be dreaded and the most to be averted, as Dr. Paxson has been emphasizing, is the anoxic depression. A narcotic depression is rather limited. In fact, it only becomes dangerous when it paves the way for anoxic difficulty.

There is no doubt that the fetus suffers from narcotic depression, from anesthetic depression, from anoxic depression, and from low carbon dioxide content.

Dr. Paxson: Miss Costello, I know you are happy at Cincinnati General, but have you met that problem in Ohio? I know you don't have that problem at Cincinnati General.

Miss Costello: I feel that there is one answer to this question. It is not only in Cincinnati: it is universal.

In surgery for the mere removal of a toenail a blood pressure cuff will be applied to the patient. But for some unknown reason, for the obstetric patient the anesthetist doesn't even deem it necessary to have a blood pressure cuff applied. Therefore, after the premedication has been given, or any barbiturate, and you have hypotension and add further hypotension, I believe it can create anoxia. I feel that if we would all see to it that we observe simple clinical signs—pulse, blood pressure, and color of the blood—we could stay out of trouble a lot more than we do.

Dr. Paxson: And keep away from 90 per cent nitrous oxide and 10 per cent oxygen.

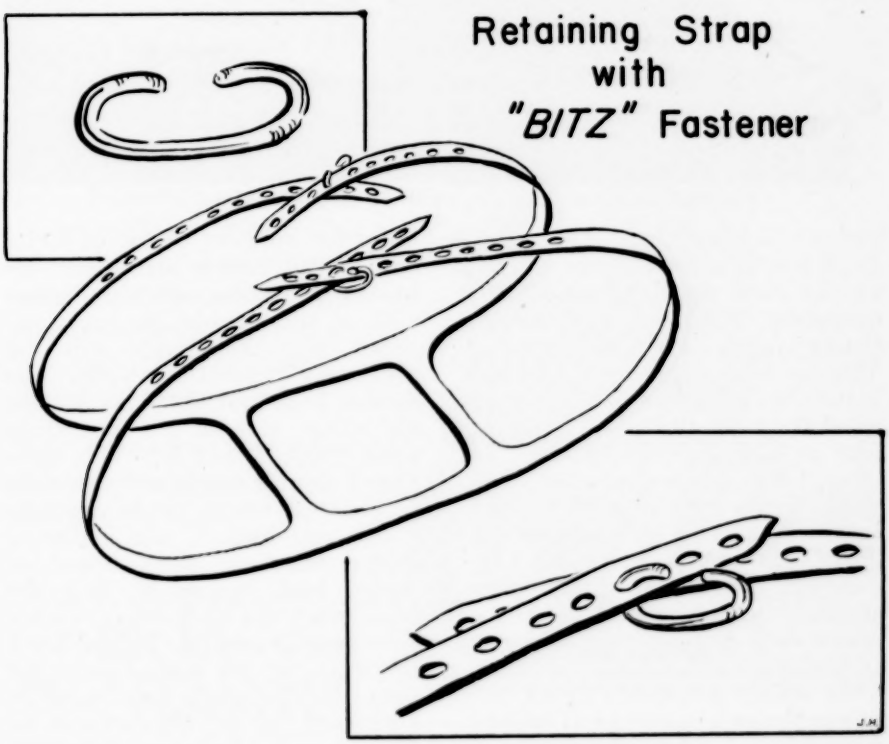
Miss Costello: Yes, sir.

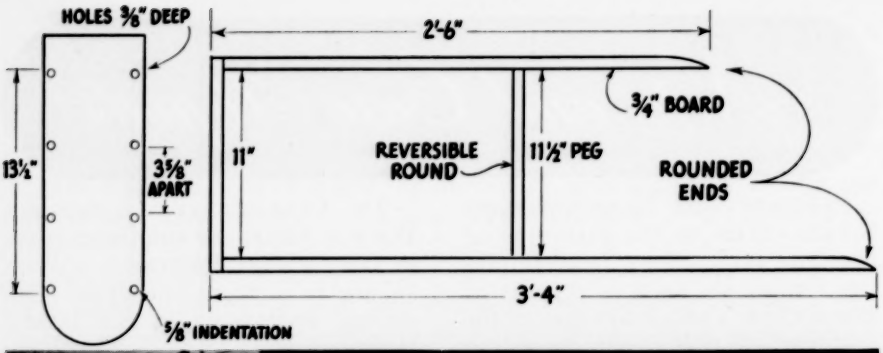
Notes and Case Reports

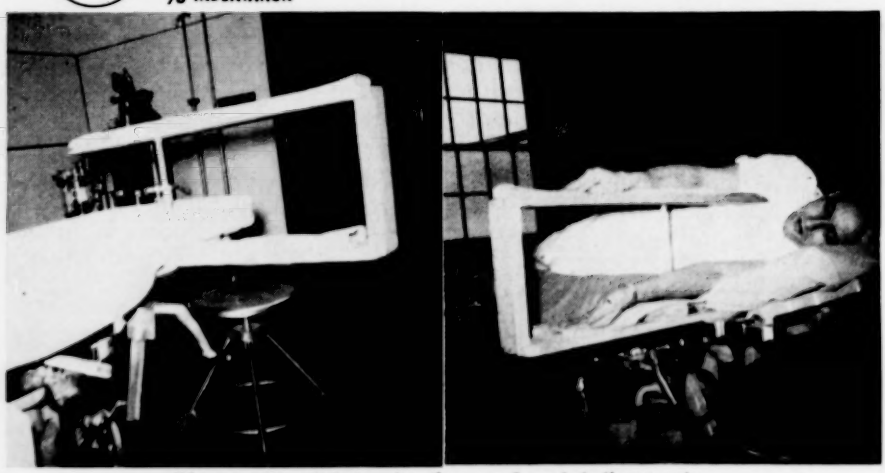
Fastener for Head-Retaining Strap.—Prior to the designing of the Bitz fastener for head-retaining straps, we used safetypins or towel clips. The advantages of the fastener are that it eliminates pin pricks in rubber gloves, saves destruction of the head strap, and is easier to use than safetypins or towel clips. The fastener is made of copper wire and is cheap, the minimal cost being 1c each.—**Major Ruth Satterfield, ANC,** Fitzsimons Army Hospital, Denver.

An Inexpensive Reversible Double Armboard for Operations in the Lateral Positions.—What to use to support the upper arm during operations in the lateral positions is an annoying problem for the anesthetist. To overcome this difficulty, I had our hospital carpenter make the illustrated double armboard (fig. 1).

Two lengths of board, ¾ inch thick and 6 inches wide, are required for the armrests. These two boards are 2 feet 6 inches long for the top rest and 3 feet 4







Figures 1 and 2 (top); figures 3 and 4 (bottom).

inches long for the bottom rest. Both boards are smoothly tapered at the ends that slip under the operating table pad and the patient's upper arm respectively. The inside surface of each board is then bored with eight matching holes for a length of 13½ inches, four on each side, for securing an interchangeable round post. The holes are ⅜ inch deep, 5/16 inch indentation from the side of the board, and 3⅝ inches apart (fig. 2). The two boards are then securely joined together at the nontapered ends with a piece of ½ inch plywood, 12½ inches long. This leaves an inside space between the two boards of 11 inches. An 11½ inch long round post is then made to fit into the drilled holes for support at the opposite end of the double armboard. By having the holes made on either side of the boards, the post becomes interchangeable and the armboard reversible. Thus, one double board works equally well for either side of the operating table (figs. 3 and 4). The completed double armboard can then be painted white, ready for use.

For padding, I use either a folded sheet on each board or folded bath towels so that the holes need not be covered with a permanent padding. By having a bilateral set of four holes, the board can be easily lengthened or shortened to fit the patient as desired. — **J. Pauline Benefiel, R.N.**, Indianapolis.

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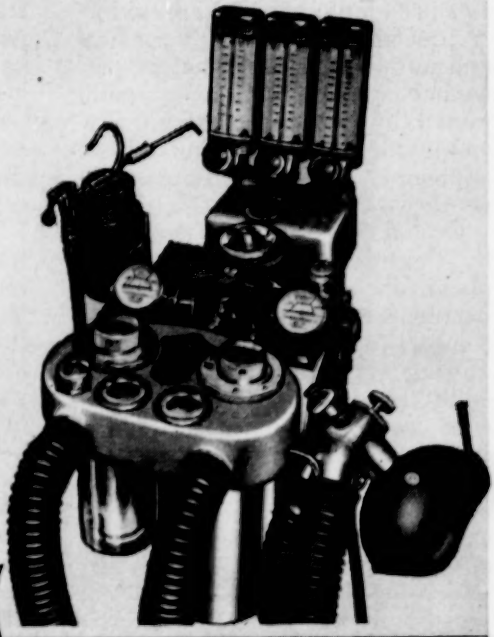

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Legislation

Employer Is Held Liable for Negligence in Blood Test for Pre-Employment Purposes.[1]—Under a decision of the Supreme Court, New York County, on Oct. 15, 1952, the court declared that an industrial corporation or a hospital operated for profit *or otherwise* would be liable for the negligence of a physician employed by it, in the use of an instrument to extract a specimen of blood for a pre-employment blood test.

The plaintiff was an applicant for employment and was required by the prospective employer, an industrial corporation, to submit to a pre-employment examination. A first-aid service, with medical and nursing aid furnished by personnel on its payroll, was maintained by the corporation. Pre-employment examination of all applicants was also a function of its medical department.

One of the physicians employed by it extracted blood from the applicant for examination by the department of health, as part of the company's management rules requiring a blood test. It was claimed by the applicant that the physician was negligent in the use of the instrument for the extraction of the blood. The question for the court to decide was whether the act done by the physician was as an independent contractor, by which he alone is responsible, or whether it was done by him as a servant of the corporation, for which the latter is responsible.

Holding that the corporation was liable upon the theory of *respondeat superior,* the court said that the physician in this case was not using his own professional discretion or judgment in determining that blood for a blood test should be taken. He made no finding and formed no opinion that blood should be taken for any purpose or treatment or cure or otherwise. He performed no medical function in the sense that he uses his medical art independently to arrive at an opinion that a blood test is indicated. The test was not pursued in the interest of a patient as part of a cure or treatment, but rather to produce a report for the employer in its business and to discover if the applicant possessed the requisite physical qualifications.

"The use of a needle for the extraction of blood might seem to require a conclusion as matter of law that it is a medical act. Yet it may be done by a nurse. Also, a nurse may use a water bottle in varying circumstances, and in one instance her act may be found to be medical and in another administrative. The same would be true with respect to the use of a needle. Its complexity and the required skill are no less in one case than in another. The doctor here was ordered to use the needle. He used no independent judgment or opinion concerning its necessity. He took no part in the actual test

1. Mrachek v. Sunshine Biscuit Co., et ano., Supreme Court, New York County, Dickstein, J., N.Y.L.J., 10-16-52, front page.

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Resuscitators

except to take the blood. He did nothing for the plaintiff as a patient, nor anything in furtherance of treatment. He obeyed an order given by his employer, and is charged with lack of requisite skill in executing that order. As his master, the defendant is likewise chargeable."

Surgeon Is Deemed Responsible for Nurse Anesthetist of Hospital.[2]—The death of a girl, aged 8, was caused, according to the complaint, by an overdose of an anesthetic administered by a nurse anesthetist employed by the hospital. A tonsillectomy had been performed by the surgeon, and the patient was then removed to her room. She died some hours later without regaining consciousness, although she was seen from time to time by the surgeon.

The hospital, the surgeon, and the nurse were joined as defendants. Although the nurse anesthetist was in the general employ of the hospital, stated the court, the surgeon could be held responsible for her negligence in the operating room, as he had full control over her there. When he occupies such a position, his duties and liabilities over the administration of the anesthesia are substantially the same as those respecting the other phases of the operation and his treatment of the patient generally. A new trial was ordered on the ground that the instructions given to the jury absolving the surgeon from liability were erroneous.

County Hospital in California Held Immune from Claims for Negligence.[3]—While the patient was anesthetized, her body and legs were burned by hot water bottles. As a result she had to undergo skin-grafting operations.

The hospital was operated by one of the counties in California. Liability was denied on the ground that the county was immune because it was exercising a governmental function. The primary purpose of the law establishing the hospital, said the court in upholding the defense, was to fulfil the function of protecting the health of the citizens by furnishing hospital services in areas where hospital facilities were not adequate, and not for the purpose of competing with any other hospital. The charging of fees to patients was not inconsistent with the exercise of a governmental function and did not, in itself, constitute the conduct of hospital business on a proprietary basis.

Anesthetic Explosion Killing Patient Not Proved To Be Fault of Hospital.[4]—An action was brought to recover damages for the death of the patient during an operation in the hospital resulting from an explosion of anesthetic gases. The Appellate Division, Second Department, reversed the judgment found against the hospital and the surgeon, as the evidence was insufficient to establish that the explosion of the anesthetic gases, which was responsible for the patient's death, was caused by the negligence of the hospital; the verdict was against the weight of the evidence. Furthermore, it was prejudicial to permit the surgeon to be cross-examined with reference to statements contained in an article written by another physician, to the effect that none

(Continued on page 130)

2. Jackson v. Joyner, 1 CCH Neg. Cases (2d) 402 - N.C., Oct. 2, 1952.
3. Talley v. Northern San Diego County Hospital District, 1 CCH Neg. Cases (2d) 397 - Calif., July 25, 1952.
4. Philipp v. Shaw et al., 116 N.Y.S. 2d 889.

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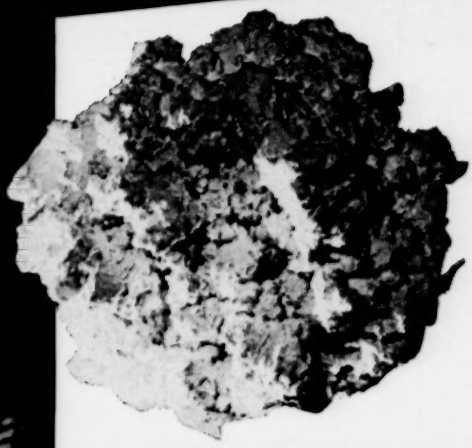

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Abstracts

Denney, J. L.; Miller, Harold; Griffith, G. C., and Nathanson, M. H.: Ventricular acceleration following procaine amide hydrochloride therapy. J.A.M.A. **149**:1391-1392, Aug. 9, 1952.

"Procaine amide ('pronestyl') hydrochloride has been recently introduced for the treatment of cardiac arrhythmias; its use has been found effective especially in rhythms of ventricular origin. . . . In 55 patients with various auricular and ventricular arrhythmias continuous electrocardiograms were made during and after the intravenous administration of procaine amide hydrochloride. We found no indication of drug induced ectopic ventricular activity in this group. However, in three patients with complete heart block the intravenous administration of relatively small doses of procaine amide hydrochloride was followed by the appearance of frequent multifocal ectopic ventricular beats in two cases and a transient ventricular fibrillation in one. It has been suggested that ectopic ventricular activity and ventricular fibrillation induced by quinidine sulfate therapy depends on an impaired function of the conducting system. . . .

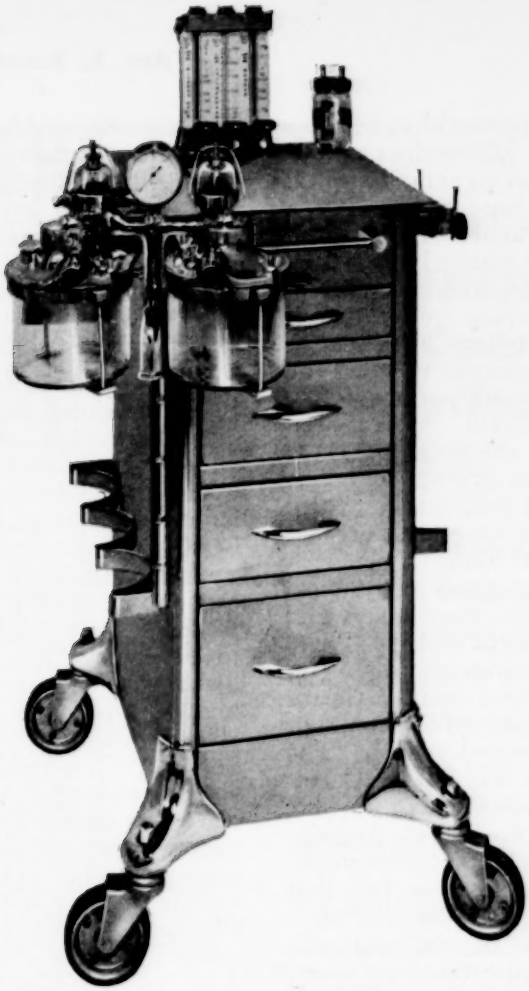
"A case of ventricular tachycardia treated with procaine amide ('pronestyl') hydrochloride is reported in which the following events occurred: (a) progressive and pronounced widening and notching of the QRS wave of the electrocardiogram, (b) a short paroxysm of ventricular acceleration of a prefibrillation type, and (c) restoration of sinus rhythm. It is suggested that, as with quinidine sulfate therapy, a widening of the QRS wave during the administration of procaine amide hydrochloride may represent a precursor to ventricular fibrillation and is an indication for discontinuance of the use of the drug."

Bakos, A. C. P., and Askey, J. M.: Fever due to procaine amide hydrochloride therapy. J.A.M.A. **149**:1393, Aug. 9, 1952.

"Procaine amide ('pronestyl') hydrochloride is a drug widely used for the elimination and prevention of ectopic ventricular rhythms. . . . A major toxic effect has been the production of granulocytopenia following bone marrow depression with death. We recently observed a patient in whom chills, fever, generalized muscle pains, malaise, dermatitis, and mental depression developed during administration of the drug. The fever disappeared abruptly when use of the drug was discontinued and recurred on two subsequent occasions after readministration of the drug. The causative relation of the drug to the fever seemed definite. . . . Procaine amide hydrochloride must be suspected as a possible cause of any febrile reaction occurring during its administration."

Read, J. M.: Fatal ventricular fibrillation following procaine amide hydrochloride therapy. Report of a case. J.A.M.A. **149:** 1390-1391, Aug. 9, 1952.

"This is a report of death immediately following an intravenous injection of procaine amide



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('pronestyl') hydrochloride. . . . A 61-year-old widow was admitted to the Elko General Hospital [Nevada] in June, 1951, after a third attack of acute weakness and dyspnea in 48 hours. . . . On the second day the patient complained of a smothering feeling, palpitation, and heaviness in the chest. That evening the nurse noted the pulse rate to be 130 and called the patient's physician. When seen at 11:30 p.m., she was apprehensive, cold, and orthopneic. She complained of palpitation, which she believed to have been present since 9 a.m. (14 hours). The neck veins were engorged. The apical and radial rates were equal and varied between 162 and 164. There was marked variation in the intensity of the first sound as heard over the apex and precordium, but the rhythm seemed regular. The blood pressure was 110/74. Carotid sinus pressure was not applied. In the light of the bedside findings and the recent electocardiographic observations, it was felt that ventricular tachycardia was present. Because of the patient's condition, prompt treatment seemed imperative.

"Accordingly 200 mg. (2 cc.) of procaine amide hydrochloride was given slowly into the left antecubital vein. The injection required three minutes, and a stethoscope was held in place over the precordium during and after the injection. The rate and rhythm remained unchanged until just after the needle was withdrawn, when, for a few cycles, the rhythm became irregular; then the rate abruptly rose and no count could be made. At this time the patient uttered a faint cry and ceased breathing for a moment. The heart continued to beat wildly and very rapidly for 15 to 20 seconds; then the intensity of the heart sounds diminished and became inaudible. Slow, irregular respirations continued for two and a half minutes after the cessation of heart sounds."

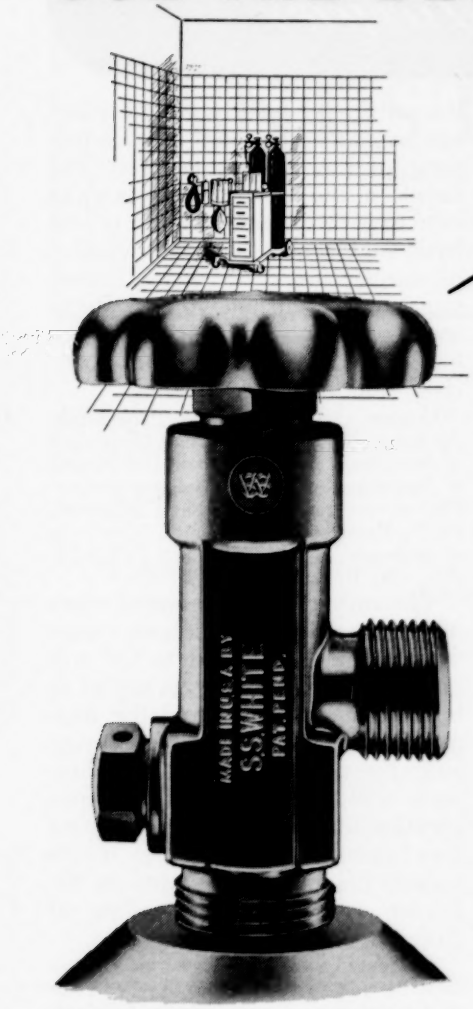
Hellman, Emanuel: Allergy to procaine amide. J.A.M.A. **149**:1393-1394, Aug. 9, 1952.

"The therapeutic similarity between procaine amide and quinidine is recognized; however, whereas the toxic effects of quinidine are well known, procaine amide ('pronestyl') has not yet been used widely enough to permit evaluation of its ability to cause toxic reactions. The following case of a true allergic reaction to procaine amide is, therefore, discussed. A 53-year-old man with known hypertension for the past 20 years was first seen on November 11, 1951, with sudden onset of severe substernal oppression. An electrocardiogram revealed acute anteroseptal myocardial infarction. . . . The patient was given 1.5 gm. of procaine amide orally; this was followed by 250 mg. every four hours. After the third dose, when a total of 1 gm. [*sic*] had been taken, a generalized maculopapular erythematous rash developed, accompanied by severe itching, congestion of the nose, slight generalized adenopathy, and a fever of 102 F. Cessation of procaine amide therapy and institution of diphenhydramine (benadryl) hydrochloride, 50 mg. every 4 hours, was followed by complete subsidence of all symptoms within 24 hours.

"Inasmuch as the patient was receiving other medication at the time of this reaction, it was decided to test him with procaine amide alone. Consequently, on

(Continued on page 130)

USE THE BEST



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Book Reviews

American Pocket Medical Dictionary. Ed. 19. Cloth. 639 pages. Philadelphia: W. B. Saunders Co., 1953.

This nineteenth edition is issued to celebrate the fifty-fifth year since the *American Pocket Medical Dictionary* was first published. Obsolete terms have been removed to make room for new terms. Tables and lists are included in the alphabetic sequence, not separated into appendices. The volume is a useful size for casual desk or classroom use.

Opiate Addiction. By Abraham Winkler, M.D., Experimental Neuropsychiatrist, National Institute of Mental Health Addiction Research Center, U.S. Public Health Service Hospital, Lexington, Ky. Cloth. 72 pages. Springfield, Ill.: Charles C Thomas, Publisher, 1953. $3.00.

The material in this monograph is a summary of recent investigations of opiate addiction, particularly at the U. S. Public Health Service Hospital at Lexington, Ky. Nurse anesthetists will be interested not only because the subject may occasionally arise in connection with their work but also because there is need for a better understanding of the sociologic problem of addiction. Ninety-nine references are listed at the conclusion of the text.

Sociology Applied to Nursing. By Emory S. Bogardus, Ph.D., Editor, "Sociology and Social Research," University of Southern California; Professor Emeritus of Sociology, University of Southern California, and Alice B. Brethorst, Ph.D., R.N., Dean of Hamline University School of Nursing; Professor of Nursing, Hamline University. Ed. 3. Cloth. 366 pages, 28 illustrations. Philadelphia: W. B. Saunders Co., 1952.

The third edition of this book has brought a complete revision of the material. The social adjustment of the nurse, personality and heredity, culture, attitudes and religion are some of the subjects covered. The family in the social pattern is given extensive treatment. This is the basis for development of discussion of larger units of society, community, national, and world medical-social problems. Each chapter is followed by a series of questions, exercises, and suggested readings.

Society and the Nursing Profession. By James M. Reinhardt, Ph.D., Professor of Sociology and Chairman, Department of Sociology and Anthropology, University of Nebraska, and Paul Meadows, Ph.D., Professor of Sociology, University of Nebraska. Cloth. 256 pages. Philadelphia: W. B. Saunders Co., 1953.

The authors have presented many of the sociologic phases necessary for the nurse to adjust to her role in society. Subjects are as varied as national health plans and the sociology of crime, economic security, and juvenile delinquency. The whole book will be of interest to nurse anesthetists. Anesthetists will find the chapters on the sociology of the patient of immediate value in obtaining a better understanding of patients who require anesthesia.

Analgesia and Anesthesia in Obstetrics. By J. P. Greenhill, M.D., Professor of Gynecology, Cook County Graduate School of Medicine, Attending Gynecologist, Cook County Hospital, Attending Obstetrician and Gynecologist, Michael Reese Hospital, Associate Staff, Chicago Lying-in Hospital, Chicago. Cloth. 85 pages, 16 illustrations. Springfield, Ill.: Charles C Thomas, Publisher, 1952.

Analgesia and Anesthesia in Obstetrics, number 159 in the American Lecture Series, is an excellent monograph. The author has used

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some material from Greenhill and DeLee's *Principles and Practice of Obstetrics* and has added a concise review of recent literature as well as material from his own experience. Throughout the book the safety of mother and baby is emphasized. All methods and agents currently being used are mentioned, some briefly. The book is approximately equally divided between general and local methods of anesthesia and analgesia for obstetrics.

Tired Feet. By Kathryn Morgan, R.N. Cloth. 147 pages. New York: Vantage Press, 1952. $3.00.

This is a love story with a background of nursing. Incidents during the training period give anecdotal background for the "girl meets boy, girl loses boy, girl gets boy" theme. This is good relaxation literature for nurses while resting "tired feet." The fact that "the boy" is suddenly discovered to be of a wealthy family will probably induce young women to enter the noble profession of nursing with the hope that the same thing will happen to them.

LEGISLATION

(Continued from page 122)

of the sixty-three static fires referred to therein occurred under a setup that was regarded as offering maximal protection, and that in none of such cases was there present even such safeguards as were then being recommended, permitting the jury to draw the inference therefrom that the explosion involved in this accident could not have occurred if proper safeguards had been adopted. A new trial was granted.

Hypodermic Injection by Nurse Held To Be Act of Medical Care for Which Hospital Was Not Liable.[5]—Medication was administered to a patient by hypodermic injection by an undergraduate nurse in an allegedly negligent manner. In affirming a dismissal of the complaint against the hospital, the Court of Appeals held that the giving of a hypodermic injection is a medical act, and that the liability of the hospital, if any, must be based upon the hospital's lack of care in selecting and furnishing the physician or the nurse by whom the act is performed. The patient had failed to show either the identity of the undergraduate nurse who gave the hypodermic medication or lack of care by the hospital in the selection of the person who gave the hypodermic injection. — **Emanuel Hayt, LL.B.,** Legal Counsel for American Association of Nurse Anesthetists.

ABSTRACTS

(Continued from page 126)

Feb. 10, 1952, he was placed on 250 mg. of procaine amide every 4 hours. Following the fourth dose, the identical clinical picture noted above developed; this condition again promptly responded to diphenhydramine hydrochloride. A stained blood smear at the height of the reaction showed 7% eosinophils as compared with ½ to 1% in the control smear before beginning the procaine amide test. A subsequent patch test with the drug was negative."

NURSE ANESTHETIST: Apply: Director, Department of Anesthesiology, Abington Memorial Hospital, Abington, Pa.

5. Bryant v. Presbyterian, Court of Appeals. (N.Y.) Opinions, 6-1, Jan. 15, 1953

Classified Advertisements

NURSE ANESTHETIST: For 276 bed general hospital. Pleasant working conditions. Salary open. Complete maintenance if desired. Liberal employee benefits. Anesthesiologist in charge of department. State qualifications and salary desired in first letter. Apply: Personnel Director, Lawrence and Memorial Association Hospitals, New London, Conn.

WANTED: Anesthetists, three; 450 bed teaching hospital. Department directed by medical anesthesiologist, staffed by medical resident personnel, and six nurse anesthetists. Southern city with cultural advantages. $400 per month with full maintenance. Periodic increases in salary. Liberal vacation and sick leave. Apply: C. A. Robb, Superintendent, Roper Hospital, Charleston, S. C.

NURSE ANESTHETIST: Well organized department performing 8,500 anesthesias per year. Modern, well equipped, 400 bed general hospital constructed in 1941. Salary range: $275-370. Apply to: Director, The Delaware Hospital, 14th and Washington St., Wilmington 1, Del.

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WANTED IMMEDIATELY: Nurse anesthetist. Department covered by twelve with 7,000 anesthesias per year. Apply: Director of Anesthesia, Henry Ford Hospital, Detroit, Mich.

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ANESTHETIST wanted to complete staff of three. 275 bed hospital located in the state capital and business center of newly developing North Dakota oil industry. Sick leave after six months; two weeks' paid vacation after one year. Write: Sister M. Paul, Director, St. Alexius Hospital, 9th and Thayer St., Bismarck, N. Dak.

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WANTED: Two nurse anesthetists for 240 bed hospital. Salary open. Partial maintenance provided. Apply: Administrator, Charleston General Hospital, Charleston, W. Va.

NURSE ANESTHETIST for 250 bed hospital, well equipped and fully approved, predominantly surgery. Top salary, meals and laundry furnished, good hours, sick leave, vacation and holidays. Apply: Administrator, Mid State Baptist Hospital, Nashville, Tenn.

ONE NURSE ANESTHETIST: 150 bed hospital; $350 per month and maintenance. Department directed by medical anesthetist. State experience. Apply to Director of Anesthesia, St. Francis Sanitarium, Monroe, La.

IMMEDIATE OPENINGS AVAILABLE: A.A.N.A. members, two nurse anesthetists needed. Obstetric anesthesia in a very active department with 350 to 400 deliveries monthly. Eight hour rotating shifts. $350 a month beginning salary with room and laundry; 50 per cent of anesthesia fee per case for second call. Social Security, and very pleasant working conditions. Apply: Administrator, Good Samaritan Hospital, Dayton, Ohio.

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WANTED: Female nurse anesthetist for new 22 bed hospital. Twenty-four hour call. Salary open. Phone Superintendent at 21 or 741, Breckenridge, Tex.

WANTED: Nurse anesthestist for 100 bed hospital. Forty hour week. Full maintenance. Liberal personnel policies. Apply to: Director of Nursing, St. Mary's Hospital, Green Bay, Wis.

NURSE ANESTHETIST for approved 113 bed hospital. Good salary, vacation, sick leave and Social Security. Excellent location near Chicago. Apply: Personnel Director, Highland Park Hospital, Highland Park, Ill.

NURSE ANESTHETIST: Male or female. 45 bed general hospital. $450 per month to start plus meals, housing, vacation, sick leave, and social security available. Apply: Administrator, Henry County Memorial Hospital, Mount Pleasant, Iowa.

WANTED: NURSE ANESTHETIST for 180 bed hospital. Five anesthetists employed. Salary $400 with meals, vacation, and sick leave. Pleasant working conditions. Hospital approved by A.H.A. and A.C.S. Apply: Superintendent, Misericordia Hospital, 1255 N. 22nd St., Milwaukee 3, Wis.

WANTED: Anesthetists. Several immediate vacancies. Salary $390 monthly. Vacation, sick leave, etc., allowed. 260 bed hospital. Apply: Personnel Department, Northwestern Hospital, 810 E. 27th St., Minneapolis, Minn.

WANTED: Anesthetist at the Community Hospital, Hutchinson, Minn. Located sixty miles west of Minneapolis and near rivers and lakes. 45 beds, moderate amount of surgery; no O.B. call. Preferably if willing to relieve superintendent on her off time. Write Superintendent.

WANTED: Immediate opening for a nurse anesthetist, salary $400, guaranteed, otherwise open. 52 bed hospital, pleasant working conditions, in Lubbock, Tex., town of 110,000. If interested contact: Plains Clinic, 2609 19th St., Lubbock, Tex.

NURSE ANESTHETISTS: For approved general hospital. Good personnel policies. Full maintenance, vacation, and attractive salary. Exceptionally good working conditions. Apply: Administrator, Randolph Hospital, Inc., Asheboro, N. C.

NURSE ANESTHETISTS (2): To increase present staff. A.A.N.A. membership required. Salary $360 per month, with periodic salary increases, plus meals, private room and bath in new women's residence, and laundry. Social Security and private pension plan. Apply: Administrator, Reading Hospital, Reading, Pa.

WANTED: Three nurse anesthetists for obstetrics and gynecology and surgery. Salary open. St. Joseph's Hospital, Lexington, Ky.

Florida opening for NURSE ANESTHETIST. Hospital expanding and building new surgical pavilion. Salary open. Communicate with: Administrator, Broward General Hospital, Fort Lauderdale, Fla.

ANESTHETIST: With experience. $400 per month, plus air-conditioned apartment. One month's vacation per year. Liberal personnel policy. College town. Apply: Administrator, Centre County Hospital, Bellefonte, Pa.

NURSE ANESTHETIST (A.A.N.A. member) to fill vacancy March 20, 1953. 150 bed hospital. Starting salary $400 per month plus complete maintenance, which includes five room furnished apartment for two anesthetists. Paid vacation, sick leave. Administrator, David Hospital, Pine Bluff, Ark.

NURSE ANESTHETISTS (2): Immediately, Pacific Northwest. 80 bed, approved general hospital, increasing to 120 beds by fall. Call rotated among three nurse anesthetists. Liberal personnel policies; Social Security. Salary $350 and up. Apply: Box D-90, Journal A.A.N.A., 116 S. Michigan Ave., Chicago 3, Ill.

WANTED IMMEDIATELY: Nurse anesthetists for 700 bed general hospital. Pleasant working conditions. Salary open. Complete maintenance. Liberal employee benefits. Apply to: Personnel Director, Grady Memorial Hospital, Atlanta, Ga.

NURSE ANESTHETIST: 250 bed general hospital. First year $350 month; second year $375; third year $400. Full maintenance, vacation, sick leave, etc. Ohio Valley Hospital, Steubenville, Ohio.

NURSE ANESTHETIST wanted for exodontist's office. Dr. Frederick E. Schmidt, 144 S. Harrison St., East Orange, N. J. Write for personal interview.

WANTED: Nurse anesthetists for 500 bed University teaching hospital; starting salary $360 per month. Stated increases; vacation and holiday leave; cumulative sick leave. Apply: Anesthesiologist in Charge, University of Virginia Hospital, Charlottesville, Va.

WANTED IMMEDIATELY: Nurse anesthetist. General 485 bed hospital. Complete maintenance if desired. Social Security, four weeks' vacation, two weeks' sick leave, Blue Cross insurance. Salary open. Apply: Chief Anesthetist, Department of Anesthesiology, St. Michael's Hospital, 306 High St., Newark, N.J.

NURSE ANESTHETIST: Starting salary $500 per month. Compensation for rotating call; 44 hour week. 50 bed general hospital. Active general surgical services. Liberal sick leave and vacation program. Apply: R. A. Gagliardi, M.D., The Lynn Hospital, Detroit 17, Mich.

WANTED IMMEDIATELY: NURSE ANESTHETIST for an established general hospital, A.C.S. approved, 120 beds. Beautiful surroundings, close to stores and theaters. Salary $325 to $350 per month plus maintenance, liberal vacation, and sick allowances. Apply: A. G. Stasel, Administrator, Eitel Hospital, 1375 Willow St., Minneapolis, Minn.

WANTED: Nurse anesthetist. 300 bed hospital, attractive employment conditions, salary open. Reply stating age and experience to J. M. Schwab, M.D., Chief of the Department of Anesthesiology, Geisinger Memorial Hospital and Foss Clinic, Danville, Pa.

POSITION WANTED, by nurse ANESTHETIST, at present employed but desirous of making a change. Foreign country preferred but would consider a domestic connection, providing the salary is a bit above the average. Would prefer direct correspondence or personal interview if possible. Reply: Box E-10, Journal A.A.N.A., 116 S. Michigan Ave., Chicago 3, Ill.

NURSE ANESTHETISTS (2): To work with present staff of four anesthesiologists and three nurse anesthetists in 325 bed capacity general hospital. All technics and agents used. Salary range $3,900 to $5,100 plus compensation for call. Month vacation, two weeks' sick leave, meals while on duty, and social security provided. Write: Samuel Rochberg, M.D., Chief Anesthesiologist, Sinai Hospital, Baltimore 5, Md.

SECOND ANESTHETIST for 115 bed modern A.C.S. approved general hospital in college town of 30,000. Several national parks within day's drive. $400 monthly. Living accommodations available in nicely furnished nurses' home. Wire: Utah Valley Hospital, Provo, Utah.

NURSE ANESTHETISTS (A.A.N.A. members): Starting salary $365; automatic increases; laundry of uniforms. Forty hour week. No obstetrics. Liberal vacation and personnel policy. SUTTER HOSPITAL OF SACRAMENTO, CALIF.

NURSE ANESTHETIST: 70 bed general hospital; A.C.S. approval; located in city of 17,000; two hours' drive from Memphis, Tenn.; lovely nurses' home; $400 plus full maintenance; alternate working shift with another anesthetist. Apply to: Administrator, Helena Hospital, Helena, Ark.

ANESTHETIST (A.A.N.A. member): 120 beds, new air-conditioned operating rooms. Alternate nights and week end call. Very little O.B. and emergency work. Starting salary $450 and complete maintenance. Apply: Administrator, West Texas Hospital, Lubbock, Tex.

ANESTHETIST: Nurse for fully approved 50 bed hospital, thirty-five miles from Chicago. Two anesthetists regularly employed. Salary $450 per month. Vacation, holiday time, and other considerations allowed. Delnor Hospital, St. Charles, Ill.

ANESTHETISTS: Openings for three anesthetists for 305 bed general hospital. Complete maintenance. Salary open. Apply: Superintendent, Altoona Hospital, Altoona, Pa.

NURSE ANESTHETIST. Beginning salary is $425 monthly; no calls. Modern 242 bed general hospital in Chicago suburb. Anesthesia staff: two physicans, five nurses. Write: Methodist Hospital, Gary, Ind.

NURSE ANESTHETIST: New 100 bed rural hospital, fee for service basis plus minimum guarantee. Live out. Need car. Average 75 operations per month. Contact: Director, Memorial Hospital of Bedford County, Everett, Pa.

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ANESTHETIST, R. N.: Thinking of making a change? Looking for a good place to work? Our O.R. is air conditioned, carries two anesthetists, and five nurses. Separate anesthetist for OB. Under 100 bed hospital, located on the Susquehanna River and Chesapeake Bay, handy to Baltimore, Washington, Philadelphia, and New York. June opening. $300 to $350 month, based on experience. Full maintenance. Harford Memorial Hospital, Havre de Grass, Md.

ANESTHETIST-NURSE: 600 bed approved general hospital; excellent salary, one month's vacation after a year's service. Apply, Personnel Director, Good Samaritan Hospital, Cincinnati 20, Ohio.

ANESTHETISTS for 485 bed city hospital, member of A.A.N.A., with an approved school for nurse anesthetists. Facilities include recovery room. Salary range: $365-$412 per month; forty hour week; paid vacation, sick leave, and holidays; retirement plan, discount privileges, and other benefits. Write: Personnel Director, Hurley Hospital, Flint, Mich.

WANTED: NURSE ANESTHETIST for 200 bed hospital. Well located, excellent nurses home, pleasant surrounding, and modern set-up. Room, laundry, and meals furnished. Salary open. Apply: Administrator, The King's Daughters' Hospital, Portsmouth, Va.

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ONE NURSE ANESTHETIST: For 125 bed general hospital. Salary open. Full maintenance. Apply to: Superintendent, Maine Eye and Ear Infirmary, Portland, Maine.

NURSE ANESTHETIST: With adequate experience to assume some supervisory duties in addition to administering anesthesia. Salary open. Apply: Chief, Anesthesia Department, The Mercer Hospital, Trenton, N. J.

NURSE ANESTHETISTS for 150 bed general hospital; 40 hour week; extra pay for call duty; four weeks' vacation plus six holidays. Salary open. Memorial Hospital, Roxborough, Philadelphia 28, Pa.

NURSE ANESTHETIST: West Tennessee general hospital increasing surgical staff. Presently 60 bed with 40 bed addition under construction. Salary open. Liberal personnel policies, Social Security, and Blue Cross. Write or call collect: Superintendent, Obion County General Hospital, Union City, Tenn.

NURSE ANESTHETIST for new 236 bed general hospital 30 miles from New York City. Live out. Salary open. State age, training and experience. Morristown Memorial Hospital, Morristown, N. J.

WANTED: Well qualified nurse anesthetist; to work with clinic group. Salary open, based on experience; all types of surgery; two hospitals associated with group, with total capacity of 150 beds. Carbondale Clinic, Carbondale, Ill.

WANTED: Anesthetist. Age limit 35. Must have one year's experience. Starting salary $400 with $50 raise each six months for two consecutive raises. Must be permanent. 150 beds. Southwestern General Hospital, El Paso, Tex.

TWO NURSE ANESTHETISTS needed for expanding anesthesia department in new building. Staff also includes anesthesiologists and residents. Excellent opportunity for application of professional ability. Initial salary $368 per month. For further information write: Director of Anesthesiology, Grace-New Haven Community Hospital. New Haven, Conn.

NURSE ANESTHETIST: No nights or week ends. Salary $350 monthly, plus maintenance. State age, training, and experience. Apply: Superintendent, New York Eye and Ear Infirmary, 218 2nd Ave., New York 3, N. Y.

NURSE ANESTHETIST: To work with anesthesiologist in 243 bed, approved general hospital. Salary open. Forty-hour work week. Four weeks' paid vacation at end of first year. Two weeks' paid sick leave at end of first year. Eight paid holidays per year. Compensation for rotating night call. Social Security. Full maintenance. Apply: Chief, Anesthesia Department, Elizabeth General Hospital, Elizabeth, N. J.

ANESTHETIST WANTED: 200 bed A.M.A. and A.C.S. approved general hospital. New and modern. Department headed by anesthesiologist. Salary open; dependent upon experience. Write: B. W. Mandelstam, M. D., Administrator, Mount Sinai Hospital, Minneapolis, Minn.

NURSE ANESTHETIST: Approved hospital near Detroit. $450 per month. Overtime after forty hours per week. Living quarters available. Wyandotte General Hospital, Wyandotte, Mich.

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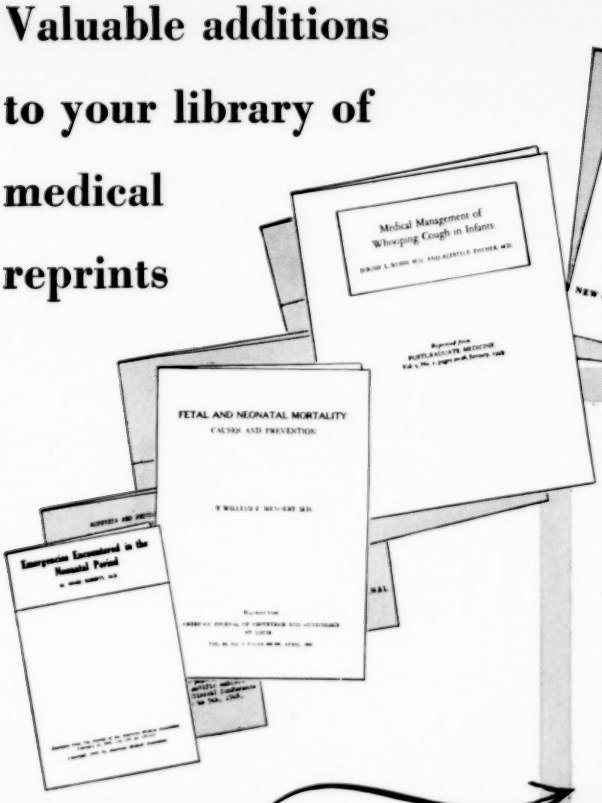
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These articles, which discuss the use of oxygen in medicine, are available from LINDE's oxygen therapy department.

1. "Care of the Toxic Newborn," Russ, J. D.: NEW ORLEANS MED. AND S. J. 101: 292-294 (Dec.) 1948.

2. "Emergencies Encountered in the Neonatal Period," Roberts, M. H.: J. A. M. A. 139:439-44 (Feb. 12) 1949.

3. "Fetal and Neonatal Mortality: Causes and Prevention," Mengert, W. F.: AMER. J. OBST. AND GYN. 55:660-668 (April) 1948.

4. "Medical Management of Whooping Cough in Infants," Kohn, J.L. and Fischer, A.E.: POSTGRAD. MED. 5:20-26 (Jan.) 1949.

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